The science news monthly

SCIENCE DIGEST

JANUARY 1966 50 CENTS ICD

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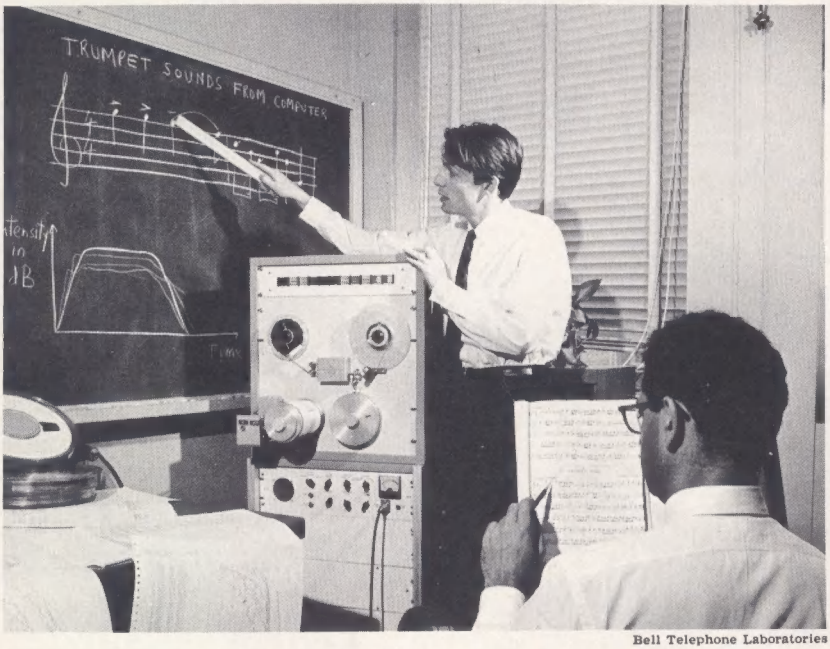
A formula for ideas that work

Columbus vs. Ericson —what science says

The bird that stood 10 feet tall

Psychiatrists tell:

WHO ARE NORMAL TEENAGERS



Bell Telephone Laboratories

Physicist and composer Jean Claude Risset follows a simple Henry Purcell trumpet composition on the board while listening to the computer-generated version on tape.

The trumpet that isn't

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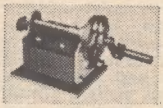

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Editorial and general offices:
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ARE science schools better equipped to educate today's young men and women than standard colleges and universities?

The question is raised—implicitly, at least—by a noted educator, Dr. Richard G. Folsom, president of Rensselaer Polytechnic Institute, on which we report in this issue in our continuing series on America's top science schools.

THIS MONTH

As the report points out, R.P.I., like other leading technological universities, is aiming increasingly at turning out well-rounded graduates with a universal outlook.

That has always been the stated aim of schools, but how often is that aim achieved in this day of accelerated, specialized knowledge?

Science is fast opening up new views of truth that seem strange to the traditional academic. It leads to the now familiar tug-of-war between "two cultures."

President Folsom says that the impact of science "requires a breadth of education and experience that is just beginning to find application in a few formal programs in higher education. Ironically, the colleges of engineering and science may be more keenly aware of the necessity than colleges devoted to a more general objective."

We may be sticking our necks out, but our series of reports thus far makes us think he's dead right.

—THE EDITORS

SCIENCE DIGEST

The science news monthly

Divers are breathing neon and oxygen in their race to the bottom. Those who go deepest first and stay longest will gather more of the ocean's waiting gifts. To find out how they'll get there and what they hope to find, see page 48.

Photo: Ocean Systems, Inc.

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SCIENCE THIS MONTH

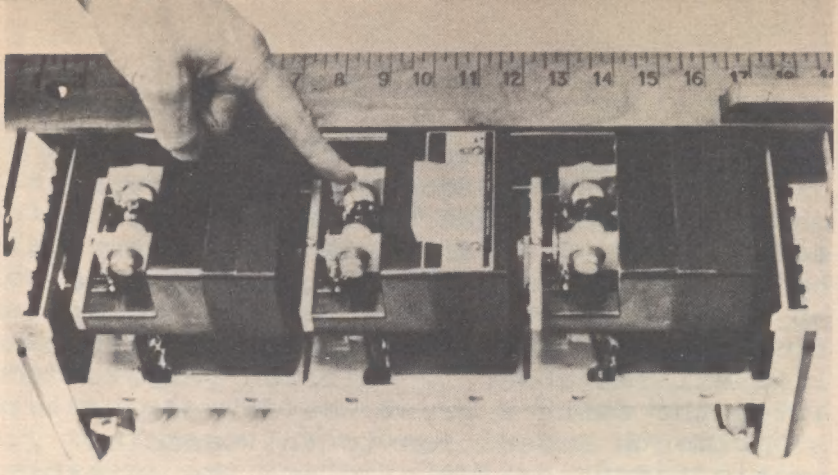
SCIENCE PANORAMA

SCIENCE MISCELLANY

THE LATE SCIENCE NEWS

EYE DAMAGE FROM DRUGS. Possible eye risks were linked to two well publicized drugs. The FDA halted human tests on DMSO, an experimental pain killer, after finding evidence that the drug impairs the eyesight of laboratory animals. About 1,000 doctors were testing the drug on 20,000 patients and the FDA suspected that thousands more were buying the chemical and using it themselves without their doctors' knowledge. Tests will continue, but on a limited carefully controlled basis. The FDA also requested manufacturers of oral contraceptives to circulate a warning about the visual hazards of the drugs. Although no cause and effect relationship has been established, research has indicated a possible connection between use of "the pill" and a slight increase in eye disorders.

NATURAL DEFENSE AGAINST CANCER. Stimulating the body's immune system to fight cancer is emerging as one of the most important and promising areas in cancer research. All signs of an incurable cancer disappeared in one patient five weeks after beginning a unique treatment to stimulate the body's natural defenses. Other partial regressions seem to have been achieved in the same test. There are also reports that Soviet scientists have had some success with a vaccine treatment that seems to delay death from advanced breast cancer.



Wide World

BLACKOUT FALLOUT. The great Northeast power failure may trigger vast changes in the entire U.S.-Canadian electrical setup. The failure started with the malfunction of a relay (of the type pictured above) in a giant generating plant on the Ontario side of the Niagara River. Engineers now know where the trouble started, but they don't really know why. The relay cut out one of the power lines in the Sir Adam Beck No. 2 plant, although there was no overload. The power was transferred to the other lines overloading them and they "tripped out in cascade." The extra power surged into upstate New York, starting a chain reaction of overloads. At each stage, safety devices should have isolated the overloaded system but didn't--at least on the U.S. side. The rest of the Ontario system did get cut off and was spared the overload. As Northern stations were knocked out, southern stations like those in New York City tried to rush power in to fill the vacuum. Their generators were inadequate and automatically shut themselves off.

CLUES TO PAST. A series of important new discoveries have added significantly to our knowledge of the history of life on earth. Prof. Elso S. Barghoorn of Harvard has discovered remains of bacteria-like objects in three-billion-year-old rocks from South Africa. This indicates that life existed about 1.5 billion years after the earth's crust was formed. A Dartmouth expedition to the Canadian Arctic found remains of clam-like animals and worm tracks in rocks 720 million years old. This extends the known history of complex animals by 20 percent. Highway excavations near Cleveland have been turning up so many fossils, that the number of known vertebrates from the Devonian period, 400 million years ago, has doubled.

PRIMATES AND DINOSAURS. The first evidence that primates, the group of mammals to which apes and humans belong, lived in the time of the dinosaurs--62 to 63 million years ago--has been found in Montana. Paleontologists from the American Museum of Natural History and the University of Minnesota note that the find pushes the recorded history of this order back about three million years.

200-FOOT TIDES. During the Paleozoic era, 200 to 600 million years ago, the moon may have been 40 percent closer to the earth and tides may have risen 100 to 200 feet. Such huge tides could have formed the extensive sandstone and limestone formations that underlie much of North America, says Dr. C. Wroe Wolfe, Professor of Geology at Boston U.

GEMINI OUTLOOK. A modification in the fuel system of the Agena rocket probably resulted in a destructive "hard start" which wrecked the target vehicle for the Gemini 6 docking attempt and caused the mission to be scrubbed. The next problem for NASA is to decide whether to go back to the old less desirable but more reliable Agena or try to iron out the bugs in the new one before trying another docking mission. While studying the reasons for the Agena failure, technicians were also preparing for the combined Gemini 6 and 7 mission which would be able to perform at least some of the experiments scheduled for the original Gemini 6 flight. Looking further into the future, rookie Astronaut Charles A. Bassett 2nd was chosen to make a "walk around the world" during the Gemini 9 mission about the middle of this year. Bassett's walk will be similar to that planned for Astronaut David Scott on the Gemini 8 mission scheduled for March.

SOVIET SPACE OUTLOOK. The Russians have confirmed the suspicion that they are now using the world's most powerful rocket to orbit the heaviest payloads ever launched. It is substantially more powerful than the U.S. Titan 3-C, previously believed to be the most powerful. The Soviets also have two space probes heading for Venus. They will reach the vicinity of Venus early in March. A 1961 Soviet Venus probe failed when radio contact was lost after a few weeks. Soviet Mars probes have also failed. The U.S. has had success with both.

SPACE MYSTERIES. A new type of telescope has discovered strange bodies invisible to conventional telescopes. The puzzling objects seem to be rare, cool (about the temperature of Venus) and enormous (hundreds or thousands of times larger than the sun). The findings were made with a new telescope at Mt. Wilson which detects light from infrared sources. . . . A Soviet deep space probe has picked up powerful, mysterious radio waves possibly from Jupiter. The Soviets had no theory to account for the radio waves which were 200 times stronger than anything scientists had expected.

E.S.P. BETWEEN TWINS. Researchers at the Jefferson Medical College in Philadelphia have found two sets of twins with "electronic" E.S.P. When one brother closes his eyes the brain waves of the other change as if he, too, had closed his eyes. The researchers are, as yet, unable to explain their results.

QUOTE OF THE MONTH: "I am haunted by the idea that this break in human civilization, caused by the discovery of the scientific method, may be irreparable. Though I love science I have the feeling that it is so much against history and tradition that it cannot be absorbed by our civilization. . . .However, my reasoning may be quite wrong. I hope so. Some day a man may appear cleverer and wiser than anyone in our generation, who can lead the world out of its impasse."--Nobel physicist MAX BORN, in the Bulletin of the Atomic Scientists.

THE MEDICAL PICTURE

Smog box

A "body box" or plastic booth for smog patients has been added to the Cardiopulmonary Laboratory, St. Vincent's Hospital, New York.

Dials allow air regulation from smog to 100 percent oxygen while the lungs' behavior is gauged. Persons with lung disorders can be treated with clean, humidified, filtered and oxygen-fortified air.

In the upper left-hand corner of this map, drawn about 1440, is a representation of Vinland, the name given America by Vikings on an almost legendary voyage of discovery.

Columbus vs. Ericson—what science says

by Daniel Cohen

IT'S BEEN proven again, for the umpteenth time, that the Vikings really did discover America before Columbus. This time the proof is so solid that it will probably end the argument.

For hundreds of years, there has been a strong suspicion that the Vikings or Norsemen landed on the North American continent around 1000 A.D. The suspicion was based on Norse sagas telling how the Vikings, sailing westward from their colonies in Greenland or Iceland, came upon a new land that they named Vinland. If the tales were to be believed, Vinland could only have been North America. The Vikings were among the greatest sailors the world has ever known, and the voyage would not have been an impossible or even an un-

usually difficult one for them. But there was little supporting evidence for the tales, and the stories themselves were so filled with obviously mythical events, that the case for the Viking discovery of America had to be regarded as unproven.

Archaeologists, historians and enthusiastic amateurs searched for tangible evidence of the Viking landing. And they found some, like the so-called Viking stone tower in Newport, R. I., and the Kensington Stone in Minnesota. Such evidence, however, was highly questionable.

In 1963, the Norwegian explorer, Dr. Helge Ingstad discovered in northern Newfoundland the remains of a settlement. The Smithsonian Institution, the National Geographic Society and the American Museum of Natural History all agreed it was Norse. For some reason, perhaps because Dr. Instad has not yet published all the results of his explorations, the find did not make the impression it might have made.

Then, late last year, Yale University dropped a scholarly bombshell. It was a map of the world drawn about 1440—over 50 years before Columbus's voyage to the New World. The upper left-hand corner of the map contains a remarkably accurate representation of Greenland, and beyond it a three-lobed land mass labeled Vinland.

The legends relate how the Vikings first sighted a rocky coast they called Helluland, next a wooded ground they named Markland and finally a fertile shore where they landed, the one they called Vinland or Vineland. This description corresponds strikingly to the three-part Vinland shown on the map. The best guess is that the three lands they found were Baffin Island, Labrador and Newfoundland, and the inlets separating them are the Hudson Strait, which separates Baffin Island from Labrador, and the Strait of Belle Isle, which separates Labrador from Newfoundland.

A sense of timing

With a fine scholarly indifference for time, Yale experts spent eight years checking and studying the map before they were absolutely sure of its authenticity. They finally released the information on, of all days, Columbus Day.

The map was bound together with the so-called *Tartar Relation,* a previously unknown account of a 7,000-mile, two-year mission to Mongolia made by a Franciscan friar, John de Plano Carpini. The trip was completed in 1247, or 50 years before Marco Polo related his famous stories of travel to China. Although most of the elements—parchment, watermarks, handwriting—indicated that both the Vinland map and *Tartar Relation* were prepared at the same time, the mid-fifteenth century, there were still loopholes. These were closed when Yale obtained, quite by accident, a copy of the *Speculum Historiale* or *Mirror of History,* a standard reference work from the 1300s to the middle 1500s. Without doubt, the

map, *Tartar Relation* and *Speculum* had been copied by the same hand and originally had all been bound together in a single volume, not an unusual practice in Medieval times.

Alexander O. Vietor of Yale says the evidence creates "a presumption of authenticity so strong as to be difficult if not impossible to challenge."

Drawn in Switzerland

The map was drawn about 1440, probably by a monk in Basel, Switzerland. But even more significant is that the drawing must have been made from source materials that dated back at least to the thirteenth century. From 1431 to 1449, a long church council was being held in Basel. It was the kind of event to which churchmen from all over the world, including Scandinavia, came and exchanged information.

There is no hint that the scribe who copied the map had ever heard of the legends of Norse voyages, and there is no reason to believe that anyone in southern Europe knew anything about them. The researchers believe that the unknown monk copied the Greenland and Vinland portions of the map from an older map brought to Basel by a northern churchman. The map was then bound into the copy of *Speculum* he was copying for the use of the Basel scholars.

The Italians, who claim Columbus as a native son, are unhappy. And the Spanish, who say that the discovery of America is their glory because Columbus sailed for the King of Spain, are absolutely furious. But aside from national pride they have been able to raise no solid objection to the map. So the Vinland map seems to have finally settled the question of whether or not the Vikings landed in America before Columbus.

However, the map opens speculation on some equally fascinating questions. First: What was the name of the Norseman who first discovered America? Most people would immediately answer Leif Ericson. One of the Norse sagas of the discovery of Vinland tells how Leif, son of Eric the Red, Viking colonizer of Greenland, got lost and discovered Vinland by accident. A second saga has the story differently. According to "Tale of the Greenlanders," in 986 A.D. Bjarni Herjolfsson, sailing from Iceland for Greenland was driven off course and became the first to sight America. Years later he told his story to Leif, who then bought Bjarni's ship and set out on a deliberate expedition to find Vinland.

Joint venture?

What does the Yale map say? On it is written, "Island of Vinland, discovered by Bjarni and Leif in company." Did they do it together? Probably not, for the map was drawn long after the event and there is a marked tendency to combine different events into a single one. Thus the map supports Bjarni.

The Vikings may have built extensive colonies in North America.

All the publicity, however, has been for Leif and it may turn out that poor Bjarni Herjolfsson is to remain one of history's forgotten heroes, perhaps because his name is so hard to pronounce.

A second question is: How long did the Viking settlement last? Tradition indicates that they existed only briefly, and that the settlers were driven out by hostile natives, although several different voyages were made. But in the Norse records is the notation that in the twelfth century Bishop Eric Gnupsson set out for Vinland, considerably after the Viking settlements there were assumed abandoned.

Map inscription

An inscription on the map adds a good deal to the story of Bishop Eric. It calls him Bishop of Greenland and the neighboring regions, and indicates he was a Papal Legate who not only started out for Vinland, but got there and spent at least a year in the territory before returning to Europe. This is strong evidence that Norse settlements existed on the North American continent as late as the twelfth century, and that they may have been fairly extensive to command an extended visit from so important a churchman.

This new information will doubtless stimulate even more intensive archaeological searches for Norse settlements in America, since the chances of finding the remains of well-established villages are far better than the chances of finding the site of a 900-year-old temporary camp. It should also stimulate a search of another kind; for when the Bishop returned he probably wrote a report for his superiors. "Where is the report?" asks George O. Painter of the British Museum. "Is it buried somewhere in the Vatican? The discovery should unleash all sorts of new research."

Did Columbus see it?

Another question raised by the Yale discovery is: Did Columbus see the map before setting out on his voyage in 1492? Since the map was drawn in Switzerland about 50 years before Columbus's voyage, it is obvious that knowledge of the Viking discoveries had not been entirely lost. Actually, before his voyage, Columbus went to Iceland and could have learned of the discovery there, but it is doubtful that he ever saw anything like the Vinland map or heard of the Viking discoveries any other way. Columbus was an avid collector of explorer's tales, and none of his copious notes contain any mention of Vinland. All the evidence he could collect indicated that his best route lay in tropical latitudes.

Says R. A. Skelton, one of the scholars who studied the Vinland map, "Not only was the knowledge

reflected in this map (if he had it) not 'useful' to his enterprise; it was simply irrelevant." Columbus was not looking for Vinland or any other newly discovered land, he was trying to find a better route to Asia.

Although Columbus has lost his claim to discovery of America, his partisans can draw a great measure of comfort from the observation of Nilo Calvini of the Civic Institute for Columbus in Genoa, Italy: "Columbus was the first to establish commercial and cultural rapport between America and Europe. It's out of the question even to conjecture that he has lost his claim."

Sailors and colonizers

This raises yet another fascinating piece of speculation: Why didn't the Vikings forge permanent bonds between Europe and Vinland? They were not only great sailors but great colonizers as well. During the Middle Ages, they could be found living as far from their Scandinavian homeland as Central Russia and Palestine. The sagas indicate that Vinland was abandoned because of the hostile actions of the Indians whom the Norsemen called skraelings.

But there is more to it than that. During the Middle Ages, the Vikings burst out of their homeland in what amounted to a frenzy of exploration and conquest. They established themselves from Vinland to Baghdad, and then slowly around the twelfth and thirteenth centuries, the Norse tide receded. Some

A drastic climate change ended the great Norse adventure in exploration.

think that a climactic change, causing the northern latitudes to grow colder, cut the Viking vitality. There are good indications that both Greenland and northern North America were a lot warmer when the Vikings first landed there than they are today. By the fifteenth century, all mention of even such a well-established colony as Greenland drops out of the Norse records. The entire area was forgotten and not rediscovered until the eighteenth century. That is one of the ways that Yale scholars knew that the Vinland map must have been based on early sources. A comparably accurate map of Greenland, they reasoned, could not have been drawn again until 1850, after a series of new trips along its coast.

Vain hopes

Early in the eighteenth century, when Greenland was rediscovered, there was some hope that descendants of the original Norse settlers would be found alive. The hope proved a vain one, and archaeology provided the grim reason. The graves contained stunted and deformed skeletons, ghastly evidence of a people dying of malnutrition and disease. Yet they were all elaborately attired in the styles of 1400, picked up and copied from the last European seamen to reach that

island before darkness closed in.

Perhaps, the question of who really discovered America first is not completely closed even now. The claim for Leif Ericson (or Bjarni Herjolfsson) looks secure, but many other legends exist. There are some massive dolmens (stone monuments) of the Celtic type around North Salem, N.H., which have given some people the idea that primitive Irish Christians visited America. And there is a particularly persistent legend that the Irish St. Brenden made a voyage to the New World around 500 A.D. There is also speculation that those indefatigable travellers, the Phoenicians may have come here long before the Christian era. And one Italian scholar recently introduced the novel theory that the Etruscans discovered America about 1100 B.C. The theory is based upon similarities between Etruscan religious symbols and practices and those of the Akawayo Indians of the South American Guianas.

On the West Coast and in Mexico and South America, too, some tantalizing hints have turned up that the Chinese or Japanese may have made landings there in the distant past.

On the extreme right side of the Vinland map, off the coast of Asia, are some unexplained land masses. Since most of the information on Asia contained in the map comes directly from *Tartar Relation* is it possible that the Mongols in some way knew of the existence of Alaska?

The Columbus-Ericson debate is (or should be) over. But the question of who really discovered North America will continue to engage the attention of scholars and archaeologists for many years to come.

Another difference between men and women

HENRY Higgins lamented, "Why can't a woman be more like a man?" Well, Henry may berate "My Fair Lady" again because research on game theory shows that men tend to cooperate more with each other than women do.

In a game of "Prisoner's Dilemma," two prisoners (players) are held incommunicado, each charged with the same crime. They can be convicted only if either confesses. If both confess, both lose. If neither does, both are acquitted. If only one confesses, he is set free and wins a reward, while the prisoner who holds out is convicted and sentenced to jail. It is in the interest of each to confess, yet in their collective interest to hold out. Hence, the dilemma.

"The most striking difference (in players), is between the male and female populations. There is a clear indication that males cooperate more than females," say Anatol Rapoport and Albert Chammah, the University of Michigan researchers who have written *Prisoner's Dilemma*, analyzing their extensive game theory research. They also found that when men play opposite women, in the long run, women are pulled up to the level of masculine cooperation. At the same time, men tend to be pulled down.

REPORT OF THE MONTH

Target for '66: a look around the moon

The mission of the Surveyor is to send back vital, precise information on lunar surface.

AMERICA still plans to land a man on the moon by the end of the decade. As the deadline draws uncomfortably near, the moon's surface remains the Apollo project's "greatest unknown," says the deputy director of the Manned Spacecraft Center.

This year, spider-legged Surveyors will make belated landings to find out what it's like, with TV cameras and other exploratory devices.

Even then, the first four will be test vehicles only. The first fully equipped probe probably won't be launched until 1967, if all goes smoothly. And that's a bad bet, judging from the project's history.

The Surveyor project is already three years behind schedule and $264 million over budget. Homer Newell, director of space sciences for NASA, told a Congressional committee last spring it will serve as a model of how not to do things. "When we undertook this program," said Newell, "I believe that none of us really had a good feeling for how difficult the project was." Consequently, the California Institute of Technology Jet Propulsion Lab (JPL), manager of Surveyor, had to enlarge the technical team from 90 to 500.

There was also friction between JPL and the builder, Hughes Aircraft, especially after two drop-test models that failed were said to be made of hardware that was not flight qualified.

At the start, however, the rocket team outfumbled the spacecraft team. Surveyor is more than three times as heavy as the Ranger craft that took photos of the moon. It needed the extra push of a new, more efficient, hydrogen-powered second stage on top of the Atlas main stage.

Delay after delay plagued the Centaur hydrogen engine right up to the launching last spring of an Atlas-Centaur topped with a model

of Surveyor. Atlas lit, lifted three feet off the pad and abruptly cut off. The rocket dropped into a cloud of flame that left Centaur a badly scorched project. The Air Force moved in to administer the *coup de grace* by trying to get Atlas-Centaur replaced by its Titan. But in the nick of time Atlas-Centaur executed a perfect rehearsal shot in August aimed at a "paper moon."

Despite this flash of competence, we nosed in first in the goofup race; the Russians got off an initial try at a soft landing in May. Their Lunik V may have provided a preview of Surveyor by slamming in at 6,000 miles per hour after its retro-rocket apparently failed to fire. Two later shots also missed.

No cinch

A soft landing figures to be no cinch. The JPL project manager for Surveyor sets the odds at one or two chances for success in the first four shots. Mercury and Gemini shots returning to earth spiral into a soft cushion of air and alight on billowy waves. Surveyor will go barrelling into solid ground through a vacuum.

Sixty miles out, Surveyor's radar will tell it that it's time to fire the retro-rocket that accounts for two-thirds of the spacecraft's weight. In 40 seconds, it will slow Surveyor from 6,000 to 240 miles per hour, braking seven times harder than a tire-squealing automobile. Three small vernier rockets for positioning Surveyor will continue firing to slow it to about 3.5 miles per hour. Thirteen feet above the ground they will be shut off so they won't chew up the surface, and the craft will drop onto soup-bowl-shaped feet at the end of tripod legs.

The first four Surveyors will have a single television camera that may find itself in the dark, depending on the month. The fifth through the seventeenth Surveyors will be outfitted for exploration, so will need two days of sunlight in which to recharge batteries. One television camera will look straight down during the approach. Two others will peer around, up and down with stereo vision. Surveyors will also listen to tremors from crashing meteorites, feel for the pinpricks of the debris they toss up that might puncture an astronaut's suit, scratch the ground as television watches and bombard the ground with alpha particles to analyze its composition. In late 1968, a cart, pinch-hitting for the scratched Prospector spacecraft, may rove out from Surveyor within camera range.

What will be found is anybody's guess. Ranger photos showed that it is best to avoid the white, rubble-strewn "rays," but scientists have agreed on little else. In the end, no changes were made to Surveyor, and NASA side-stepped the issue by taking no official view.

If Surveyor fails, NASA may orbit astronauts around the moon for a direct inspection. If Surveyor sends back bad news, it may take two years to redesign the landing gear for the Apollo.—*B. F.*

What are 'normal' adolescents?

by Flora Rheta Schreiber and Melvin Herman

THE PHRASE, normal adolescent, may seem like a hopeless paradox to many psychiatrists, says Dr. Daniel Offer, assistant director of the Institute for Psychosomatic & Psychiatric Research & Training of Michael Reese Hospital & Medical Center, Chicago. "The prevalent concept of adolescent turbulence does not evoke images of so-called normal behavior."

But although many psychiatrists regard adolescence itself as a form of illness, this is not to say there are no adolescents who steer an even course, who are not disturbed. The question is: Who are they?

The need for a good hard look at the normal teenager has caused Dr. Offer to take on the responsibility of heading a long-range study of normal high school boys. Dr. Roy R. Grinker, director of the Institute, says, "Psychiatry too long has neglected this question."

One of the investigators, Dr.

Melvin Sabshin, chairman of the Department of Psychiatry, University of Illinois College of Medicine, told us in an interview that a most important aspect of the study is "that as psychiatrists we are going into the community to see a different sort of boy than the sick kids we see in our clinics and offices."

Most studies, until very recently, have concentrated on the disturbed adolescent. And there is a particular need for studies of normal adolescents, says Dr. Offer, "as it is often very difficult with adolescents to differentiate health from illness or normal turmoil from a pathological process."

The pivotal difficulty is a definition of normal behavior. One of the goals of the study is to arrive at an operational definition of normality and health.

Institute researchers were first confronted with the task of selecting their "normal" group. As Dr. David Stafford-Clark, in his book, *Psychiatry Today*, has put it, "The concept of normality is in fact fundamental to any study of the abnormal; and yet when we examine this concept we see at once that there are more ways than one of forming a judgment of what is normal." We tend, Dr. Stafford-Clark adds, to frame our answer around what we have experienced ourselves, and this is particularly true when we consider adolescents. We base our ideas on our memories of ourselves as adolescents and on the behavior of our children.

Normal may also be taken as m e a n i n g, without fundamental disorder or aberration, occurring naturally. This may be an ideal concept that is hard to measure.

Normal may also be the average, which the investigators believe is measurable in this instance. Dr. Offer and his associates gave tests to all the male freshman in two high schools, one just north and one just south of Chicago. And, with Dr. Sabshin, he devised a self-image questionnaire for adolescent boys. They also used the Bell Adjustment Inventory.

Adjustment level

Each test included a number of sub-tests and scales intended to measure one aspect of the way a boy regarded himself. Altogether, Drs. Offer and Sabshin believe they provided a good picture of the boy's ability to adjust.

After the tests were given to several hundred freshmen, one-third of the group were selected for study. They were boys whose scores on all the sub-tests came closest to average. Therefore, boys who scored highest and might have been extremely well adjusted were eliminated, as were those who scored lowest. Boys with uneven scores in some sub-tests also were eliminated. Dr. Offer was after the modal (average) adolescent. The test findings also were checked against any serious behavior problems on the school records.

The plan is to hold forty-minute

depth interviews with the boys about four or five times a year for a number of years. The study is now halfway through the first three years. Dr. Sabshin says it may go on for eight years. There also will be additional interviews with their parents.

A problem was to secure the cooperation of even the normal adolescents. Would they stand still to be questioned? The answer is that they have cooperated, perhaps for two contrasting reasons: 1. Adolescents are notably egotistical and enjoy airing their views. 2. They are altruistic; those taking part in this study found pleasure in the promise given them by the investigators that the findings would be used to help other teenagers. A third reason for the good rapport between the investigators and the investigated was the elasticity of the schedules. At first, half the group missed their appointments. The proportion has dropped to one-fifth now that interviews are held after school hours. Parents make sacrifices, too, as many of them do the driving and must make two round trips on the day of the interview.

Home interviews

Interviews are followed by home visits and observation of the boys in school. It is necessary to evaluate their functioning in many different ways, for a boy can master one aspect of his world while failing to adjust in another.

Among boys with average scores, a surprising 50 p.c. were first or only children.

Most of the boys come from one level or another of the middle class, and one of the drawbacks of the study, Dr. Sabshin points out, is its middle-class limitation. Yet the findings may well hold true for middle-class communities in any metropolitan area.

No divorced parents

Notably, none of these modal boys has lost a parent because of divorce, although the parents of three have been separated. Two parents have died during the study thus far.

The position of the boys in their families also is interesting. More than half the group are either the first child in the family or an only child. "This is a striking statistic," says Dr. Offer. He adds, however, that "it only may reflect the tendency of families to move to the suburbs when the first child is ready for school."

Findings to date are: The normal adolescent is well-adjusted, but knows he has problems and knows what those problems are. "Psychiatrists would be happy if their patients at the end of therapy were

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Miss Schreiber is an award-winning writer on psychiatry; Herman, the Executive Secretary of the National Association of Private Psychiatric Hospitals.

as aware of their problems as these boys are of theirs," said Dr. Offer. Like disturbed boys, these normal boys have feelings of shame, guilt, depression and anxiety. But, unlike the disturbed, they are not afraid to look at themselves and to admit their feelings.

These normal adolescents, as a group, don't worry about the state of the world. What they regard as their central problems are: (1) to do as well in school in preparing for a vocation as is demanded by their families' hope for them; (2) getting along with people, including their own parents; (3) the perennial problems of religion, money and sex.

Just daydream

Despite what Kinsey and other reporters have said about sex in America, this study is showing that boys of this age have a conservative sexual code. Many of them daydream about one special girl, but do not readily admit doing so; 5 percent of the boys (they're now high school sophomores) go steady; 35 percent only group date; 35 percent do not date at all. About 20 percent smoke; only a few drink.

Normal as these boys are, they have taken flings at more or less anti-social behavior. Age 12 or 13 found them stealing things from a local store or indulging in some other mode of behavior that could have caused them to be classified as delinquents. But delinquency did not become the pattern of their

lives in any sense. Yet they are sympathetic to juvenile delinquents. Moreover, they blame juvenile delinquency exclusively on parents and society, not on the boy himself.

These boys are not rebels against their parents or their parents' generation. In fact, they share their parents' values. Family quarrels center not on genuine clashes of point of view, but rather on being chauffered in the family car or on the curfew hour. Most of the boys rate their parents as understanding and reliable but mothers are rated as easier to discuss problems with and generally closer.

Dr. Sabshin told us that one of the interesting elements of this long-range study will be "charting the degree of change that occurs and the social climate in which it takes place."

But of the boys as they are today, Dr. Offer's comment is, "They're tremendous."

Perfectionism

THE drive to perfectionism is so great it even can lead to suicide, says Marc H. Hollander, M.D., Department of Psychiatry, State University of New York.

He cites the case of a 22-year-old woman who became depressed and attempted suicide when she felt she had failed to perform perfectly as the mother of her infant son. Dr. Hollander says, "The striving for perfectionism exists when a person demands of himself or others a higher quality of performance than is required by the situation." By focusing on the imperfections in his work, the perfectionist deprives himself of the satisfaction of a job well done. He also may work much longer on a job than necessary, showing little or no concern about the time involved, or he may set himself unrealistic demands to produce work in much less time than it should actually take.

Perfect performance

In perfectionistic strivings the child is father to the man. Typically this trait is developed by a sensitive child, whose insecurity intensifies his need for acceptance. He tries to please his parents by a perfect performance. In time, he internalizes this demand and works as a perfectionist for himself alone. Parents, of course, aid and abet this process when they in turn set standards that are too high for their children.

The dynamics of perfectionism can become very involved. For after a while even the self-imposed standard may become too much to bear. The next step is to transfer this demand to another person. Accordingly, the perfectionist reaches the point of believing that anyone who praises him is uncritical, or insincere, or his dupe.

Curiously, the perfectionist seldom becomes top man on the totem pole. Instead of becoming the "number one" man who must take

an overview of an operation and engage in long-range planning, our perfectionist remains just a painstaking worker. Often, too, he must work alone because his goading demands bring him into conflict with others.

Primary thinking

FREUD categorized the primary thinking process as primitive and unrealistic. In its most extreme form, it appears in acute schizophrenics, in children, and in drunks. This type of thinking reveals basic urges which may be expressed illogically and in defiance of the social situation. Freud contrasted this level of thought to a secondary process which is orderly, rational and based on experience.

The primary process, according to Freud, not only dominates our dreams and daydreams, but often breaks into the conscious state. According to psychoanalytic theory, the control of this primary process is an essential element of normal thinking. The more, therefore, that we understand about the primary process in normal people, the more we might get to know about what happens to those persons in whom the control system has broken down.

A program known as Psychoanalytic Studies in Cognition, under the auspices of New York University and supported by a grant from the National Institute of Mental Health, is trying to test the primary process of thinking experimentally and its relationship to good mental health and mental illness. At the same time, the investigators, Robert R. Holt, Ph.D., and George S. Klein, Ph.D., are attempting to test the theory of psychoanalysis by experimentation.

"In a mentally ill person, thought doesn't simply shatter into a thousand pieces like a windshield. It breaks along lines of cleavage that still retain some structure. We'd like to find those lines. You might say, we are looking for a method in madness," says Dr. Holt.

Essentially the line of attack seems to be through perception, sight and hearing.

Things we see or hear, without knowing that we see or hear them, are recorded in our minds and affect our thinking. A few years ago a flurry developed over subliminal perception. It was thought that advertisers could use this approach to project hidden messages.

But messages or other material received subliminally have only a symbolic influence, say Drs. Holt & Klein. For instance, students who were shown the words "room" and "water" under conditions in which the words were practically invisible, did not respond with those words when they were asked to write the first twenty words that came to mind. Instead, these students tended to write words referring to women and to feminine symbols. According to psychoanalytic theory, room and water represent feminine symbols.

New look at the universe

Half the celestial objects may consist of antimatter, but what can we do to check the theory?

IF YOUR THEORY of the universe makes no provision for antimatter, you may be ignoring half the objects in the sky.

A recently completed review of the theoretical implications of the symmetry of matter and antimatter makes this a distinct hazard for professional, as well as amateur, cosmologists.

Writing in *Reviews of Modern Physics*, a publication of The American Physical Society, Professor Hannes Alfvén of the Royal Institute of Technology, Stockholm, Sweden, emphasizes that elementary-particle physics has demonstrated the complete symmetry between the two kinds of matter. Therefore, "it seems logically unsatisfactory that cosmological theories should be based on the assumption that the universe contains only matter and no antimatter."

By this criterion, the two most popular theories of our universe's origin and development, the "steady state" and "expanding universe" models, are incomplete.

Professor Alfvén also suggests that a number of astronomical spectacles may be attributable to large masses of antimatter "annihilating" with ordinary matter. Among these are the various emissions of radio stars, supernovae, and quasi-stellar sources (quasars).

To verify or disprove any hypothesis about the antimatter content of the universe, one of only two experimental methods is available. The first depends on the fact that subatomic particles of antimatter bend in just the opposite sense of ordinary matter when moving through a magnetic field. However, for tests on an astronomical scale, the second method, annihilation, provides an almost practical test. It is "almost practical" because our ability to throw matter at suspicious celestial objects is limited.

Not the moon

We can, for example, be sure that the moon is not made of antimatter since terrestrial rockets have crashed there without generating the kind of explosion that would be expected of an annihilation. But, as

Professor Alfvén points out, "by direct observation it is at present impossible to decide whether a distant celestial object consists of matter or antimatter, and we cannot exclude that, for example, half of the celestial objects in the universe consist of antimatter."

Another fascinating question raised by the possibility of regions containing large amounts of antimatter is, "How can antimatter and matter exist in space without rapidly annihilating each other?" The answer may be that there is an insulating layer between regions of matter and antimatter similar to the insulating layer is set up in the "Leidenfrost phenomenon."

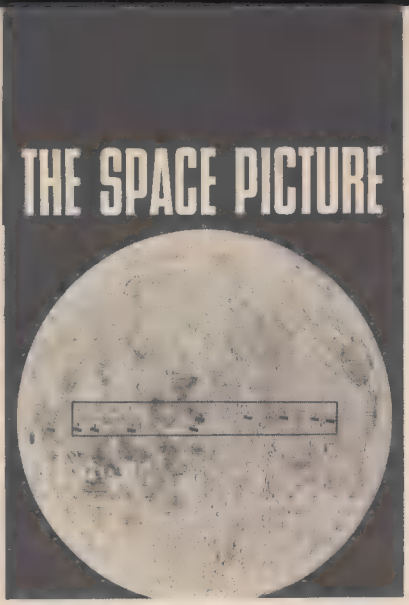
Superheated vapor

This is an effect that occurs when a liquid is dropped on a hot surface. If the surface of a stove, for example, is hot enough, drops of water falling on it form globules which, rather than evaporating immediately, may last for several minutes. The globules are insulated from the direct heat of the stove by a layer of superheated vapor. Calculations by Professor Alfvén on a similar mechanism for matter and antimatter show that a thin, very hot layer of ambiplasma (a "gas" of subatomic particles and antiparticles) may provide an adequate insulating boundary.

One theory of the universe that does consider the existence of both kinds of matter is Professor Oskar Klein's theory of the metagalaxy. In his view, the initial condition of the world was an extremely dispersed gas of subatomic particles and antiparticles. Under gravitational attraction, this "ambiplasma" contracted until annihilation occurred, producing a radiation pressure that reversed the gravitational contraction. All the galaxies were then formed, and are considered to constitute the "metagalaxy" (a term sometimes used synonymously with "universe").

In broad outline, the theory resembles the expanding universe model. It differs critically, however, in two aspects of the "beginning." First, instead of attributing the current expansion of the universe to an initial explosion of ordinary matter (only) from a highly compacted state formed by gravitation, it is assumed that annihilation of matter and antimatter reversed the inward gravitational collapse. Second, this "turning point" required an average density of matter of only one particle per every 100 cm^3, which is a few thousand times higher than the present average density in the metagalaxy. The expanding universe picture, on the other hand, requires an initial density equal to that of nuclear matter.

Calculations based on Professor Klein's model of the metagalaxy give values for the present average density of the universe and its rate of expansion in satisfactory agreement with observations. The theory also allows for the existence of other metagalaxies outside the limits of our own.



Above: Moon map shows the ten areas selected for special study by Lunar Orbiter. The areas include examples of all known major types of lunar terrain.

Mapping the moon

ALMOST forgotten amid the publicity for the more spectacular Gemini and Surveyor programs, is the Lunar Orbiter spacecraft, another important step in America's plan to put a man on the moon.

Due to be launched some time this year, Lunar Orbiter will circle the moon on an eight-day picture-taking mission. The craft will

Technicians in clean room check the retro-rocket that will be used on a moon-orbiting spaceship that will measure solar and other energy in the moon's vicinity.

...and earth

swoop as low as 29 miles above the lunar surface.

Satellite exploration of the earth is also in the news. The Geos-A satellite (right), launched late in 1965, has been radioing back measurements required by scientists to establish a more precise model of the earth's gravitational field and other geodetic information.

Below: Artist's sketch shows planned Improved Delta rocket shedding three solid fuel strap-on rockets after launch. Improved rocket will orbit heavier loads.

Space fashion show features new-model "bubble" helmet that will replace white helmet for Apollo astronauts. "Bubble" is smaller and gives them better vision.

INVENTIONS PATENTS PROCESSES

Instant sunglasses

EYEGLASSES that react to the light—darkening into sunglasses in sunlight, becoming clear indoors—will be the first use of a material devised last year by Corning Glass Works of Corning, N. Y. The glass is called Bestlite photochromic glass.

Indoors, the new glass is essentially colorless and transmits more than 90 percent of the light. That is almost identical to clear ophthalmic crown glass used in regular prescription glasses.

In sunlight, the glass darkens in one minute to allow about 78 percent of the light through. In an hour, the light transmitted drops to 66 percent. That compares with 64 percent at 85° F with Shade A green sunglasses. After the same length exposure at 25° F, the glass transmits about 36 percent of the light. That compares with 39 percent for a standard Dark Shade C green sunglass.

The glass recovers from the tint about halfway in five minutes, three-quarters of the way in 20 minutes.

While tinted, the glass is a neutral shade which allows true color perception. The material is darkened by near ultraviolet radiation in sunlight, but is only slightly affected by tungsten and fluorescent lighting at normal distances. For example, it does not darken to oncoming auto headlights at night or to mercury vapor lamps used to illuminate highways.

A new type of glass for prescription lenses will clear indoors, darken outdoors.

In tests on the glass, two years of continuous outdoor exposure did not change the light-sensitive behavior.

Mechanical snooper

A mechanic's dream—a way to spot engine trouble before a major breakdown—is being developed as a listening technique.

Mechanical Signature Analysis should aid assembly line inspection techniques, non-destructive testing, early diagnosis of machinery failures and reduce maintenance costs.

General Electric's Advanced Technology Laboratories in Schenectady, N. Y., are developing the process of using sound and vibration signals to investigate mechanical interiors. The work is under a contract from the U.S. Army's Frankfurt Arsenal.

Vibration patterns from tank engines are recorded while the tanks run at full power in the field. These are shipped to the labs for analysis. So far, the process has successfully identified malfunctions in pistons and rings, damage to principal bearings such as wrist pins and connecting rods and valve malfunctions of various types.

The above applications of MSA deal with active systems which generate noise. In passive systems such as sealed assemblies and permanent structures, sound vibrations are injected into the system to obtain readings.

Conventional testing of sealed electronic assemblies after shipment calls for a current to be applied and the output measured. But this only establishes that electrical circuits are working at the moment. It does not show mechanical damage or weaknesses that might prevent the circuits from functioning with a component failure.

Not art patterns, but a useful industrial control system, these glass plates have been etched to clear a path for fluid channels. Called fluid amplifiers, the plates recognize and follow instruction signals. Corning Glass Works developed the plates.

Joseph Gibbons, a GE engineer, says, "The impact of Mechanical Signature Analysis could extend to hundreds of fields. The receiving docks equipped with a damage analyzer could reject parcels with damaged contents without internal inspections. Structural weaknesses in bridges and buildings as well as electronic assemblies would be detected before they became dan-

gerous. Entire assembly lines could be subjected to continual analysis to vastly improve quality in mass-produced products."

Cheap desalter

A low-cost, ion exchange process to take the salt out of brackish water has been developed by Rohm & Haas Company of Philadelphia, Pa.

The process is recommended to condition water supplies with a range of 500-3,000 parts per million salinity.

The new process, according to Rohm & Haas, uses a series of three ion exchange units. The brackish water travels through the first unit and the organic content is reduced. In the second unit, a cation exchange solution dealkalizes the water. The third unit removes carbon dioxide.

The first unit may be regenerated cheaply with ammonia or lime. Since the same substance, Amberlite IRA-68, is used in the first and third units, the units may be alternated.

IBM Corp. fabricated these computer memory units on silicon chips 70/1000th of an inch square. Each has 16 circuits, four diodes, five transistors and four resistors.

The cost of treating water by this process is three to six times less than the conventional ion exchange chemical system. The new ion process can be used to treat water low in hardness but high in mineral acidity, for sewage wastes and certain industrial wastes. Checks show the water is of high quality.

Spotting corrosion

An important maintenance problem, corrosion of aircraft fuel tanks, will be eased for the Air Force with a new ultrasonic corrosion detector.

Corrosion begins when contaminants in the fuel attack the aircraft's wing skin through breaks in the fuel tank coatings. Fuel tanks are integral parts of the wing structure. Corrosion can cause the wing to weaken and fail.

Presently, fuel is drained, the tanks purged and an inspector enters them. Sometimes, the sealant must be removed for visual inspection, a costly and time-consuming process. In tests of C-130 aircraft surfaces with overlapping metal joints, only five percent of the corrosion spotted by the ultrasonic equipment could be found by visual inspections.

The corrosion detector is designed to scan the top and bottom of the wing and curved sections of an aircraft. It can scan more than 500 square inches of wing surface

in 15 minutes. It was developed by Automation Industries, Ultrasonic Division, Torrance, Calif., for the Air Force.

The detector, mounted on a trailer, is guided under the wing of a parked aircraft and raised until it touches the metal wing underside. Ultrasonic waves are then bounced against the skin of the aircraft.

Ultrasonic scanning gives facsimile recording of corrosion with good definition and sensitivity through metal surfaces fifty-thousandths to one-and-one-half inches thick. Sound waves detect a corroded area, pips are reflected back and show up as mottled areas on the recording. Focused longitudinal waves and test frequencies at 10 and 15 megacycles have produced the best recordings.

Tests have checked out corrosion on C-124, KC-135 and F-102 aircraft. The Air Force also plans to check large booster cases and to test honeycomb bonds in large cargo aircraft with the new instrument.

Tower that flies

Jockeying a 50-foot tower into place on top of a 35-foot base is a rough job. Kaiser Aluminum engineers have devised a method of using a helicopter to install the tops of 500 transmission towers that will carry 230,000-volt lines for the Gulf Power Company.

A trial run of the helicopter in action took place in Fort Worth, Tex., recently. The 'copter transports an assembled V-section to the tower location where the vertical mast has previously been installed.

Guy wires and rigging weighing 2,500 lbs. are carried via 'copter to the mast at left.

The helicopter touches the V-section down so a cable threaded through the tip of the mast can be hooked to the bottom of the V-section. The 'copter then climbs up until the V-section is above the mast. The cable is winched down and the section thereby aligned in position. In the trial run, the helicopter lifted a 50-foot, 1,700-pound V-shaped top section atop a 50-foot vertical mast. It was tied down in only 11 minutes. Shorter tie-downs are expected in field operations.

INVENTOR OF THE MONTH

She built a better mouse

Maria Perego Caldura stands behind Topo Gigio as he entertains Ed Sullivan.

IN ENGLAND several years ago, Ed Sullivan saw a tape of an intriguing Italian puppet, and signed up its operator for his American television program. Topo Gigio, the little Italian mouse, introduced in 1963, has become a regular on the show.

Many viewers have wondered how Topo can be made to act so naturally. A recent U.S. patent 3,212,213 does much to explain.

Topo's originator, and *Science Digest* Inventor of the Month, is Mrs. Maria Perego Caldura of Milan, who comes to this country every few weeks to take personal charge of the manipulation.

Topo (for mouse) and Gigio (diminutive for Luigi) looks tiny on the screen and is made of plastic that seems to give him an inner glow. In character, he is portrayed as good-natured, sleepy and guileless.

Mrs. Caldura, or a substitute, puts two fingers of one hand down inside his hind legs. With the other hand the invisible operator manipulates rods that open Topo's mouth and waggle his tongue.

Free fingers can pull cables that roll the mouse's eyes and curl up his toes.

Topo's arms and hands are moved by a second operator. Topo's voice, Giuseppe Mazzullo, memorizes his lines in English.

A trademark of the mouse act has been Topo's request for a last kiss. Once a truck driver, recognizing Ed Sullivan at the wheel of a car on George Washington Bridge, shouted cordially, "Hey, Eddie, you 'keesa' me good night?"

The mouse's "keesa" equipment, incidentally, is something special. The rods that control Topo's mouth are hollow. Although he has not been called on to do so in the American show, he is capable of what the patent calls "emissions and deglutitions of various products." In plain words, he can drink, eat—and spit things out.—*Stacy V. Jones*

New hope for ailing hearts

by Arthur J. Snider

WHEN YOUR heart is working normally, the physician hears only two sounds per beat. The first, a "lub," occurs when one pair of heart valves is driven open and another pair floated closed. The second, a "dub" is heard when the two pairs reverse their actions.

Sixty to 80 times a minute for every minute of one's life, the incessant lub-dub, lub-dub, lub-dub can be heard in the four-chambered, double-acting pump that is the amazing human heart.

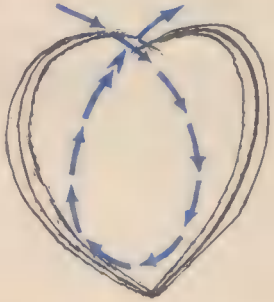
But trouble begins when a disease process has so thickened or deformed the valve leaflets, that they fail to close properly, thus permitting back leakage.

With the advent of the heart-lung machine, surgeons corrected many of these structural defects. Others, however, proved beyond repair.

Five years ago, the era of surgical replacement of diseased valves with artificial devices opened. Doctors, seeking to copy nature, tried to duplicate the flexible leaflet action of normal valves.

Most of these were crudely fashioned from pieces of dacron, sometimes covered with silicone rubber. There were some encouraging results at the outset, but the prostheses failed in long-term performance, chiefly because of material fatigue and tissue flexibility.

Compelled to bend back and forth with every heart beat, dozens of times a minute, the inert materials could not withstand the punishment. Furthermore, there were technical difficulties in attaching the valves to hard-to-reach anchors.



About this time, two surgeons, one in Washington, D.C., and the other in Portland, Ore., were pioneering a valve that worked on an engineering principle that did not attempt to copy the structure or method of action of the natural valve.

Their valve consisted of a ball placed in a cage. The ball simply moved up and down. Pressure of the blood lifted the ball from its seat, permitting flow around it. When the pressure let up, the ball

returned to its seat, sealing off any backflow.

Several hundred such ball valves have been placed in patients with varying results.

A back-to-nature move became evident at the recent meeting of the American Heart Assn. Convinced that the best long-term results can be achieved with a leaflet mechanism closely approaching the normal valve, Dr. Benson R. Roe, chief of heart surgery at the University of California, San Francisco, told about a new type of flexible material, an elastic, rubber-like substance of exceptional durability, from which leaflets, less than a twenty-thousandth of an inch thick, are fashioned.

"Artificial stress testing with a pulse simulator has demonstrated the leaflets will maintain their integrity and flexibility for the pulse equivalent of 10 to 19 years at pressures which far exceed those exerted under normal conditions," Dr. Roe says.

After three years of study on dogs, the valve is now suitable for human implantation.

"The flexible leaflet valve has several distinct advantages over the caged ball valve," said Dr. Roe. "It provides a normal central jet stream unimpeded by turbulent flow around a ball. It has a larger opening which is not limited by the size of the ball. There is no need for a metal cage which promotes clot formation and makes insertion of the prosthesis more difficult. The noise made by the moving ball, a source of annoyance for many patients, is eliminated."

In spite of the early day failures with flexible leaflet valves, Dr. Roe believes, enough evidence now has been gleaned to show that the problems of materials, construction and performance have been overcome.

How to sneeze

One would think that so elementary a reflex as sneezing would come naturally and harmlessly. Quite the opposite is the clinical truth, says Dr. David Mezz of Brooklyn. A considerable number of sneezers injure their nose, sinuses or middle ears by performing this simple act incorrectly.

For example, there are the grim-visaged, lip-locked individuals who direct the exiting force of the sneeze completely through the nose with shattering effect on the nasal membranes and the air pressure within the middle ear, he says. Physicians see many cases of nose bleed resulting from this sneeze.

Then there is the "polite" sneezer who smothers the sneeze or, worse still, aborts it. Either technique creates a pressure within the head, provokes nosebleed or ear discomfort and may infect the sinuses.

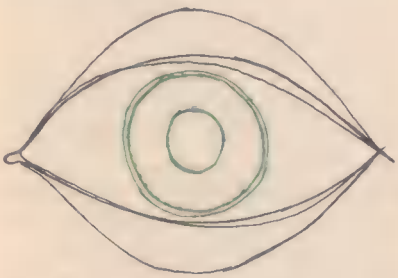
The "fire-alarm" sneezer scares the daylights out of everyone with a blast that combines the nasal eruption method with an ear-splitting vocal accompaniment.

"The safe way to sneeze is sim-

plicity itself," advises Dr. Mezz. "All one need do is to keep the mouth open and permit the force of the sneeze to be expended orally. To block the spray effect, cup the hands at the mouth or if you have time to reach for a handkerchief or tissue, place them at your mouth. I have even used a hat when an unexpected sneeze developed in a theater."

New eye transplants

Preserved corneas have been used with good results for many years in replacing diseased "windows" of the eye. Now medical men at the University of Missouri are demonstrating that grafts of sclera, the white outermost coat of the eyeball, can be highly useful, too.



Failing sight due to retinal detachment can be corrected by surgical transplantation of "slings" of sclera from donated human eyes.

Retinal detachment develops from a hole or tear in the retina. Success in recovering vision in the affected eye depends on closing the tear by fusing the retina and the next outer layer (choroid) of the eye.

There has been considerable improvement in this type of surgery in the last few years. Preserved sclera is believed the best material at the University of Missouri.

Sclera also can be used to prevent rupture of the eye globe, a common and dread complication in retinal detachment. The rupture occurs because of a marked thinning of the walls of the globe. Patching or reinforcement of the weak area can prevent the accident.

How to quit smoking

In January, 1964, the advisory committee to the Surgeon General completed a year of investigation on cigarette smoking and concluded it was "a health hazard."

Since then a variety of methods has been used to help individuals discontinue smoking. Enough experience has accumulated for Dr. Starr Ford Jr. of Cincinnati General Hospital to attempt a critical evaluation of the most popular techniques.

"No single method of therapy for ending the cigarette habit has proved strikingly effective," Dr. Ford concluded. "The long-term results from clinics have been particularly disappointing. The cigarette habit is ingrained by frequent repetition over most of an individual's adult life and is as difficult to break as other habits, such as overeating or drinking to excess."

In one group-psychotherapy effort, only three of the 17 who completed the course were still abstaining 18 months later. In various smoking clinics, less than a fourth of the patients continued to abstain from cigarettes.

A number of drugs have been used, including astringents, tranquilizers, stimulants and nicotine "substitutes."

Simplest of the remedies tried are anesthestic lozenges and astringent mouth washes to substitute unpleasant sensations to deter the smoker. Anticholingergic drugs have been used to make smoking more distasteful by drying the mouth. Sedatives or stimulants have been used to control the symptoms of nervousness, irritability, fatigue or depression that frequently accompany the discontinuation of smoking. A compound, lobeline, which shares many pharmacological properties with nicotine, has been tried widely as a nicotine substitute, but in at least six studies it proved no more effective than a placebo.

Dr. Ford says the scientific consensus is that true addiction to cigarettes does not occur. The overwhelming evidence points to phychological and social factors.

Wine and spaghetti

Alcoholism is more prevalent in France than in Italy even though a larger proportion of the Italians drink wine. The difference is that Italians customarily see alcohol, especially wine, as a food. Wine is drunk almost exclusively with meals.

Ten ounces of wine taken with a meal by a 150-pound man will produce essentially the same blood-alcohol level as five ounces taken on an empty stomach. When the food in the body includes the slowly absorbable carbohydrates typical of the Italian diet, the central nervous system is protected from the toxic effects of alcohol.

These facts are noted in the book, "Drinking in the French Culture," written by Roland Sadoun, director of the French Institute of Public Opinion; Dr. Giorgio Lolli, director of the International Center for Psychodietetics, and Dr. Milton Silverman, director of the California Wine Advisory Board.

Other reasons listed by the authors as contributing to the differences between the alcoholism rates of the two wine-consuming countries include: (1) Italians set much lower "safe limits" than do the French for the amount of wine which may be taken without harm

by adults and, especially, by children. (2) There is a wide acceptance among the French that copious drinking is somehow associated with virility. No such concept is noted among Italians. (3) The French accept socially intoxication as humorous and fashionable. Among Italians, intoxication is regarded as a personal and family disgrace. Only 13 percent of Frenchmen remembered their first drinking experience as part of a normal family meal, compared with 83 percent of Italians.

Contrary to the stereotyped belief that all Frenchmen drink only wine instead of water, nearly half of French citizens drink water every day, the authors report.

The "conk" that burns

A do-it-yourself "reverse permanent" to straighten hair is causing minor to severe burns and painful lymph node swelling in the neck, according to a report in the *Archives of Otolaryngology* by two Los Angeles physicians.

The process, attempted by Negro men, is popularly called a "conk," Dr. Thomas J. McDevitt and Dr. Mario J. Acquarelli write. The home conk material consists of a paste of potatoes, eggs and lye. The paste is applied to the scalp and allowed to remain until no longer bearable, then is rinsed out and a heavy coat of petroleum jelly is applied to the scalp and allowed to remain for several days.

When done by a competent barber, the physicians said, hair-straightening is a relatively harmless process, but the self-mixed, self-applied home conk can bring patients to a head and neck surgeon.

Poison in the well

A rise in "well-water disease" is being noted in many rural areas of the nation. Dr. Wilson P. Bailey of Kirksville, Mo., says it is due to nitrate poisoning in the drinking water.

While it has been known there were nitrates in drinking water, due in part to the use of increasing amounts of nitrogen type fertilizers, the problem was not considered serious until recently when farmers began to lose herds of livestock from unknown causes. Examination by the U.S. Department of Agriculture showed nitrates to be present in large quantities.

Further studies showed that the same water source was being used in many cases by the farm family with the resulting rising incidence of well-water disease.

Symptoms of nitrate poisoning include a gray coloring, lack of appetite, nausea, weakness, fatigue, rapid pulse rate, possible convulsions and cardiac failure, Dr. Bailey says. Treatment of the poisoning is well-established and effective if the patient is seen in time. But more attention must be devoted to prevention.

Water supplies consisting of shallow wells and small ponds or cisterns near barnyards or silos are the greatest source of concern, according to Dr. Bailey.

Big cancer riddle

Fifty-five years ago, Peyton Rous, working at the Rockefeller Institute for Medical Research, found that a cancer appearing spontaneously in a Plymouth Rock hen could be passed to other hens by inoculating them with tumor juices from which the cancer cells had been filtered out.

It was the first demonstration that cancer in animals could be caused by a virus.

Since then, evidence has piled up to show viruses produce cancers in chickens, frogs, mice, rats, rabbits, hamsters, deer and many other vertebrate animals.

Is man exempt? Many investigators believe it to be highly unlikely that the human being is unique among biological organisms.

Yet efforts to establish the virus relationship have thus far met with frustration.

Scores of new viruses indeed have been discovered in and about human cancers. Some have even produced tumors when injected into animals. But they are harmless to man. They turn out to be "passenger" viruses, just living in the human system without causing disease.

Occasionally, an investigator will report finding particles in human leukemia patients similar to those found in leukemic mice. But there is no proof these particles are actually viruses.

Many authorities feel there is a tendency on the part of such "discoverers" to read too much into their findings.

Dr. Clyde R. Goodheart of the American Medical Assn.'s new Institute for Biomedical Research believes that the efforts being made to discover a viral link with cancer by this head-on approach is doomed to disappointment.

To prove beyond doubt that a specific human virus is responsible for a specific cancer, it would be necessary to inoculate the agent into another human being, produce the cancer and recover the agent again.

Actually, it would be necessary to inoculate newborn infants before they become susceptible to the virus, Dr. Goodheart points out, and then wait for some 50 years to judge the results.

The ethical and practical barriers rule this out and require a more subtle approach.

"I believe that if we get some understanding of how viruses interact with cells, we will be able to use a less direct approach and come to a conclusion much sooner," he says.

At the Institute, Dr. Goodheart is devoting his attention to determining how tumor viruses transform the normal cell into a cancerous one by altering its genetic material.

Whisk broom in the sky

Wide World

Comet Ikeya-Seki's glowing tail was recorded in El Paso just before dawn.

by Jeanne Reinert

THE swath of light in the sky "looked like a whisk broom worn out in the middle," said Dr. Kenneth Franklin of the Hayden Planetarium. He was speaking of the dazzling celestial display of the comet Ikeya-Seki just after its recent near brush with the sun.

If its tail looked a bit ragged and worn, small wonder.

The comet's hairpin turn around the sun had brought it within 306,000 miles of the solar system's center. Much of its nucleus was vaporized and the molecules were swept by solar winds into the tail or into empty space. A Tokyo observatory reported great puffs of vapor burst from within the comet. As the sun's pull grew stronger, Ikeya-Seki's speed reached a million miles an hour.

It was the eighth recorded of a family of sun-grazing comets. The last one travelled by the sun in 1882, breaking into five pieces. All of these comets are thought to be remnants of a giant comet that was torn apart in the past. The total number is unknown.

To earthbound watchers, Ikeya-Seki became brighter and brighter until it rivalled a full moon. Tokyo observers reported that the nucleus disrupted just before perihelion, that moment when a comet comes closest to the sun.

The journey of a comet is something like a roller coaster ride with one giant hill. As the comet plunges down the hill, or toward the sun and perihelion, it goes faster and faster. The speed produces considerable heat and the comet begins to glow until it is visible with the naked eye, even during the day.

As the comet travels away from

the sun, it slows down and cools. By next spring, Ikeya-Seki will resolidify into a few miles of space debris and will have travelled out of reach of viewers on earth, even those with telescopes.

One such path, termed a period, requires from three and one-half years to several thousand years. Because so many comets ply their way through the skies in long elliptical paths, they are unknown until they begin to heat up in their approach to the sun. Jan Oort, a Dutch astronomer, has estimated that perhaps 100 billion comets may circle the sun. Gravitational pulls of the sun and planets combine to nudge about 12 comets toward the sun annually. Ikeya-Seki was the sixth comet spied in 1965.

Plainly visible

The comet could be seen plainly with the naked eye for two days in the southwestern U.S. Although haze obscured it in the northeastern part of the country during perihelion, it was visible for weeks after perihelion just before dawn.

Ikeya-Seki's appearance caused astronomers to hustle to haul out all types of measuring mechanisms. A $3 million flying laboratory, christened the "Galileo," filled with equipment, was flown west from Honolulu to acquire data. Rockets with cameras on board were launched from the White Sands Missile Base in New Mexico.

When results were in, a Russian prediction that the comet would crash into the sun was wrong. An early report from Caltech that the comet was hotter than theory would allow turned out to be a misinterpretation of equipment readings. The rocket pictures failed to be relayed back to earth.

Spectroscopy

Other results, however, were a boon to astronomers. It was an opportunity to analyze the comet's components with spectroscopes, instruments that analyze light spectra. In 1882, spectroscopy was a youthful science and little faith was put in the readings. This was particularly true when the combination of elements was never observed again in the light of other comets. The close approach to the sun causes elements to be torn apart into constituent atoms which can be analyzed.

Elements found in Ikeya-Seki included iron, calcium, potassium, nickel, copper and rare forms of carbon. Dr. Franklin said iron and potassium are especially rare. He added that few molecular lines were present; mostly atomic lines were registered, as the extreme temperatures experienced by a comet so close to the sun caused molecules to disassociate.

Other components of comets are frozen gases. These become luminous when they get close enough to the sun for ultraviolet rays to make the gases fluoresce, or give off cool light. Comets have been called

"dirty snowballs" because of their frozen gas and debris.

An observatory in France measured the coma, a combination of head and nucleus, to be roughly 3,000 miles in diameter. The tail, at its longest, spewed across the sky for 75 million miles. The longest tail on record was 200 million miles long.

Amateur astronomers

Two astronomers in particular were jubilant about the comet. They were T. Seki and Kaoru Ikeya, two Japanese amateurs who discovered the comet one month and two days before perihelion. T. Seki, according to Dr. Franklin, teaches classical guitar. Kaoru Ikeya is a self-taught sky watcher. He built his own telescope four years ago, when he was 19 years old, at a cost of $22. The hairpin comet is the third comet he has discovered in his nightly vigils between 3 and 5 a.m. During the day, he polishes piano keys at a factory in the town of Bentenjima.

Divine displeasure

Until the mid 1700s, comets were believed to be signs of divine displeasure. In 11 B.C., a scribe recorded that a comet heralded the death of Agrippa. Josephus mentioned in 66 A.D. that a comet appeared before the destruction of Jerusalem. Turks were overrunning southeastern Europe in 1456 when a comet was seen.

It took an Englishman, Edmund Halley, to analyze astronomical records, query Newton to find out what a comet's path would be if it circled the sun, and to determine that comets were regular members of the solar system. He predicted the return of a comet in 1758 based on a 75-year period. Although Halley did not live to see it, the comet did return and was named in his honor. Halley's comet will return again in 1985.

"Your hour is up, Mrs. Bradford."

TIPS AND TRENDS

NEW SHAPE OF THE WORLD. The earth, once thought to be flat, then spherical, then pear-shaped, has changed shape again. After a study of data from satellites, scientists at the Johns Hopkins Applied Physics Laboratory says the earth's a geoid, which is basically spherical, but with 4 barely perceptible "corners" that bulge 60 yards beyond the earth's roundness.

HOW TO GET TO MARS. The man who directs the building of the Saturn V lunar rocket thinks it will suffice for a variety of missions to Venus and Mars. The most ambitious: An 18-month, 12-man expedition to Mars starting in 1984. Wernher von Braun of NASA said several Saturns would place the spacecraft and propulsion systems in orbit around Earth. These would be assembled, then start out. A mission would set out later from Earth to pick the men up. They would use nuclear power to blast off.

INSTANT ELECTRIC POWER. That's what most utilities could not provide after their generators shut down in the Northeast power failure November 9. Reason: Steam plants take too long to start up. Alternative ways to get quick power, useful also to handle normal peak loads: Jet engines (already in use in Hartford, Conn.), combustion turbines and diesel units. New York City's Consolidated Edison Co. is planning another approach: Water pumped to a mountaintop is released in a rush whenever needed.

"THE CHEAP GASOLINE." That could be the boast of oil companies when and if they make gas in quantity out of coal. Hydrocarbon levels in coal would be boosted to those in petroleum by the addition of hydrogen. The coal would first be dissolved and filtered. A pilot plant is now being built by Continental. If successful, the process could produce gas for 11¢ a gallon.

MEDICAL ELECTRONICS BOOM. Pacemakers for ailing hearts, lasers for optical disorders and a host of other new medical electronic equipment are bringing a boom to a new industry. Expected 1965 sales: $350 million.

WHERE NOT TO BREATHE. A U.S.-sponsored survey of air pollution around Buffalo found a 100-percent higher death rate from lung diseases among men 50-70 in polluted air than in unpolluted air. The indicated culprits: two bands of air containing sulphur compounds and soot from factory smoke. The death rate from all causes was 20 percent higher in the air-polluted areas. Hopeful footnote: President Johnson signed a bill requiring controls of exhaust fumes on all new automobiles by 1967.

COLD VACCINATION. That's the promise of work done by University of Virginia medical researchers. In tissue culture tests, they have been able to inhibit the action of rhinoviruses, present in common colds.

MUMPS VACCINATION. University of Illinois researchers have been able to vaccinate animals against mumps, may begin testing the vaccine in children this spring.

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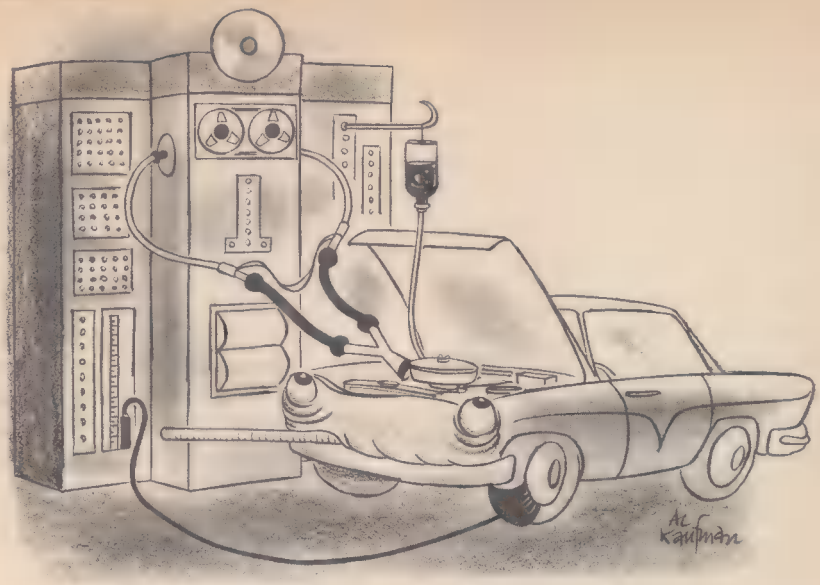


Electronic car doctor

Sophisticated equipment is now being used to diagnose car troubles before they result in a major repair job.

by Stanley L. Englebardt

THE CAR was of recent vintage, but it just didn't seem to be performing right. It wheezed and sputtered on cold mornings, had some trouble making the steep grades, a tendency to smoke too much. There was nothing you could really put your finger on. What it needed was a checkup.

A few days later, the car was wheeled into the 62-foot Diagnostic Bay operated by Mobil Oil Co. in Cherry Hill, N.J. It was subjected to over 75 different tests and checks. What the experts found was this: Its engine was idling about 10 percent below peak efficiency; its fuel consumption at 50 mph was at least 15 percent over normal; and two of its sparkplugs were fouled.

A year or two ago, these minor problems wouldn't have been detected in most service stations—at least until they developed into more troublesome items. And by that time, the cost of the repair would have gone up considerably.

Today it is possible to diagnose car ills long before they reach the big trouble stage. This is the concept behind a revolution in the automotive service industry—a

revolution exemplified by the new electronic car-care centers springing up across the country. Here the old "educated guess" is being replaced by modern "scientific analysis."

At Mobil's new diagnostic center, there is a rather striking parallel between the methods used at a modern medical clinic and those employed by the center. After depositing his car, the owner is ushered into a neat, air-conditioned lounge. First step is an "interview" with a "diagnostician" who fills out a diagnostic data form showing, among other things, the make, model and year of the car. Reference performance specifications relating to the vehicle are then attached to the data sheet. After this, either while you relax in the lounge or watch the entire diagnostic operation through an observation window, your car is driven into the Diagnostic Bay, literally wired for sound and reaction, and put through its paces.

Three phases

The actual examination falls into three phases:

Phase one involves a general inspection of tires, battery, lights and belts. During this checkup the oil and coolant levels are checked, and a three-drop sample of the transmission fluid is analyzed with a chemical reagent to determine its acidity or degree of oxidation.

After this the wheels of the auto are lowered onto the rollers of a chassis dynamometer. This is a unique instrument which provides a means for absorbing and measuring power transmitted from the wheels. A motor mounted on a balanced frame transmits its torque to the rollers through a series of shafts and gears. Then numerous transducers supply signals to meters on the console board indicating the speed, friction horsepower, power balance, acceleration, road horsepower and wheel balance of the car.

Electronic analyzer

In phase two, the car is "wired" to a large electronic analyzer console. The engine is started and operated under cranking, idle and high engine rpm conditions. As the engine speed is changed, the ignition analyzer, volt amp tester, spark advance unit, blow meter, gas analyzer and other instruments evaluate performance. Then the car is put in gear and the same series of tests repeated. Finally, the rear wheels are placed on the dynamometer rollers and tested for power.

Moving on to phase 3, the attention now shifts to wheel alignment. With front wheels positioned on the rollers of the aligner machine, the device is moved horizontally and vertically to keep it perpendicular to the plane of rotation of the wheel. In this way the degrees of angle of toe, camber and caster can be determined accurately.

This just about completes the diagnosis—except for the "medical report." As the car owner sits down,

Several major companies are now planning big auto care centers.

the diagnostician explains: "We've compared the performance of your car during the diagnosis against specifications. This sheet will show you whether or not the various tests were satisfactory."

Surprisingly, that's about all there is to it. No pressure to "get it fixed" or "do it now." The "patient" has been thoroughly examined and the verdict is in. As for fee, anywhere from a modest $6 to $10.

The obvious question is: Why hasn't this been done before?

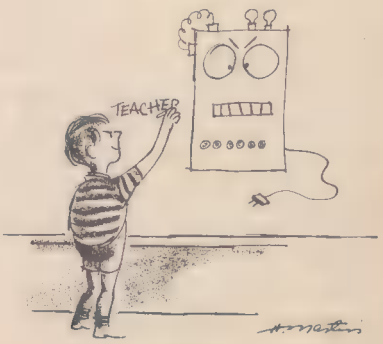
The answer is *cost*. A center of this type requires an investment of about $1 million in facilities and electronic equipment. Few—if any—service stations can afford this kind of expense, so the first step was up to big business.

Right now, several major concerns are either in or planning to get into the multi-billion dollar auto service field. Included are Mobil Oil, Shell Oil, Mansfield Tire, Macy's, Gimbels and even the A&P grocery chain. In some cases, the centers will be equipped to do repairs; in others, just to perform diagnostic functions. In either case they will use electronic gear of extremely advanced design.

From the car owner's standpoint—the man who has to shell out the repair dollars, in other words—this concept provides an entirely new approach to auto care. Instead of waiting for a breakdown and then going into the shop and saying, "I think my carburetor's gone," the owner now can take preventative maintenance measures while his vehicle is still in reasonably good shape. And while this won't assure him of trouble-free operation, in the long run it is almost certain to reduce his repair bills.

Car clinics are also providing important feedback information for Detroit. So far, electronic diagnosis has pointed the finger at fuel, ignition and front suspension as the source of the largest percentage of problems. After these come headlights, tail lights, directional signals, brakes and wheel alignment.

Besides telling *you* what ails your car, eventually this kind of data could lead to better engineered autos.



The race for riches under the sea

by Bruce H. Frisch

"GET WET, young man," is good advice—for 1980. Today it is just part of the overoptimism that pictures the ocean as a source of illimitable wealth.

Industry has been attracted, but not fooled. Ready to plunge, it has only dipped a toe.

"Much is going on in oceanography these days," *Barron's,* the financial weekly, found recently. "In dollars and cents, however, it adds up to relatively little." And much of the activity is by an overexpanded aerospace industry looking for new fields in which to apply its talents.

The truth is that the ocean is still in the age of exploration; the age of exploitation is yet to come. When a Geneva treaty went into effect last year, exploration took on the atmosphere of a landrush. Under the provisions of the treaty, a country is entitled to everything that is on or under the bottom out to a depth of 655 feet, which marks the outer edge of the continental shelf. Riches beyond that go to the nation that can get there first.

The race is on in submarines, diving suits and robots, with the biggest payoffs to those who can go deepest and stay longest.

Already, about eight new subs are in the water. Four more will be in the swim by the end of the year, and an additional six are in the works. Like to charter one? Westinghouse plans to charge $5000 to $7000 for a few hours' dive in a new saucer.

The oil industry is leading the way to deep water. Here is a possible ocean floor operation of the future: refinery, tank farm, submarine tanker, workers' homes.

The deepest dive made by a sub has been to 6,000 feet by *Alvin*, a two-man boat built by Litton Industries and run by the Woods Hole Oceanographic Institution. But *Aluminaut*, the biggest, with a twelve-man capacity, is slated to go to 15,000 feet. The all-aluminum craft, built by Electric Boat for Reynolds International, has reached 2,700 feet during trials off the Bahamas. In the future, the Navy plans to reach 20,000 feet in a deep-search boat built to withstand the pressure of almost 1,000 atmospheres at 30,000 feet.

After the *Thresher* tragedy revealed how helpless we were to rescue, or even find, a sunken sub, the Navy launched the Deep Submergence Systems Project. The first boat, a rescue sub, is due in July, 1967. It will be flown near a disabled sub by C-141 transport plane, carried closer by ordinary submarine to where it can dive as deep as 3,500 feet and couple to the escape hatch to remove a dozen survivors at a time.

A search sub that can go to 6,000 feet is planned for 1969, and one to reach 20,000 feet will appear some years later.

Hulls of super steel can withstand pressures down to 10,000 feet. At greater depths, designers will have to turn to high nickel maraging steels (used in rocket casings), titanium, fiber-glass reinforced plastic or glass and glass-ceramics.

Almost all of the subs, civilian and military, are designed to stay down no more than a working day of 10 to 12 hours. Last April, a project began under Vice-Admiral Hyman Rickover to build an atomic-powered five-or six-man vessel to stay down at least 40 days. It may hit 10 to 15 knots and go to a depth

of 1,000, 2,000 or 3,000 feet.

Once real work begins in deep water, the question is who is going to do it, men or machines? It is the same question being knocked around among space planners.

Leader of the robots is a mobot (Underwater Universal Mobot), which has operated 300 feet down off the Oregon coast tightening bolts on a Shell Oil well. Its master sits in a ship above, following the action by the mobot's television eyes and sending instructions down a connecting cable.

The Navy also has a robot which it has used to recover lost torpedoes.

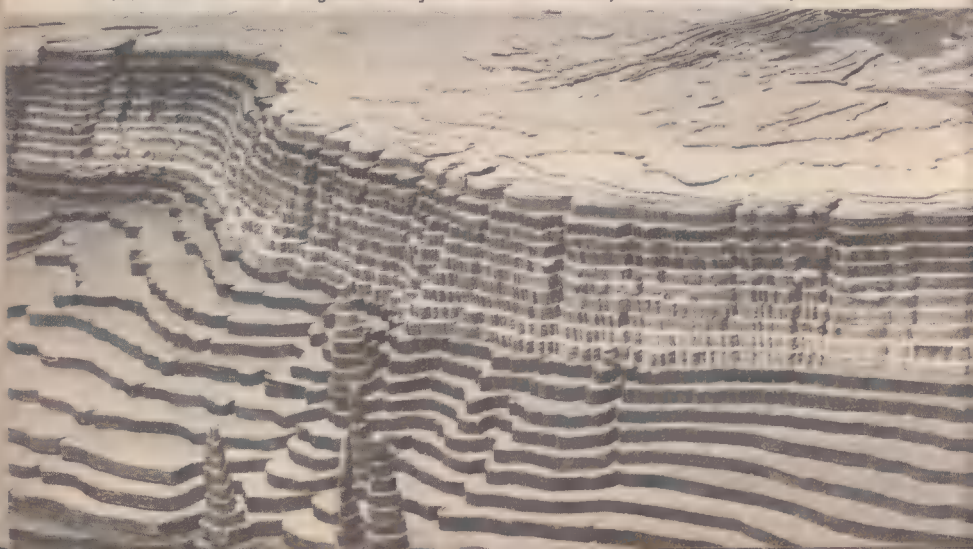
The builder of the mobot, Hughes Aircraft, has found little interest among other oil companies. Nevertheless, its collaborator, Battelle Memorial Institute, is going ahead on more elaborate remote-controlled robots.

Divers are confident. "I like robots; they give our divers a lot of extra work," says an executive of Ocean Systems Inc. Ocean Systems, sparked by Edwin (Link-trainer) Link, is racing the French and the U.S. Navy in making the deepest, longest dives. The French are usually first; the Navy, the most thorough. Ocean Systems hopes to become the richest.

The first depth reference mark is 380 feet, where Navy divers work as a regular thing. The deepest dive for a practical purpose was made to 525 feet by Divcon Associates to repair an oil well head. Experimental dives have been made by Hannes Keller, a Swiss mathemati-

The place

The Continental Shelf slopes gently to its boundary at a depth of 600 feet, where the bottom plunges to the deep ocean floor. This model shows the Georges Bank part of the shelf off New England. Canyons scar its flanks; five seamounts spike its toe.



cian, to 700 feet, and for a brief swim, to 1,000 feet.

Now the aim is to stay at these depths for the long times necessary to do large amounts of work. With old methods, Navy divers spent 30 minutes at 380 feet. With new methods, men of the Experimental Diving Unit spent 11 days in Sealab I at 193 feet off Bermuda during the summer of 1964. Shifting to La Jolla, California, they spent 15 days at 205 feet in Sealab II last summer. Astronaut-turned-aquanaut M. Scott Carpenter stayed down a full 30 days. The Navy's eventual goal had been to perform regular work at 600 feet. After Sealab II, optimistic officials talked of pressing on in five years to 1,700 feet. Here, the pressure will crush the bones of an unarmored diver.

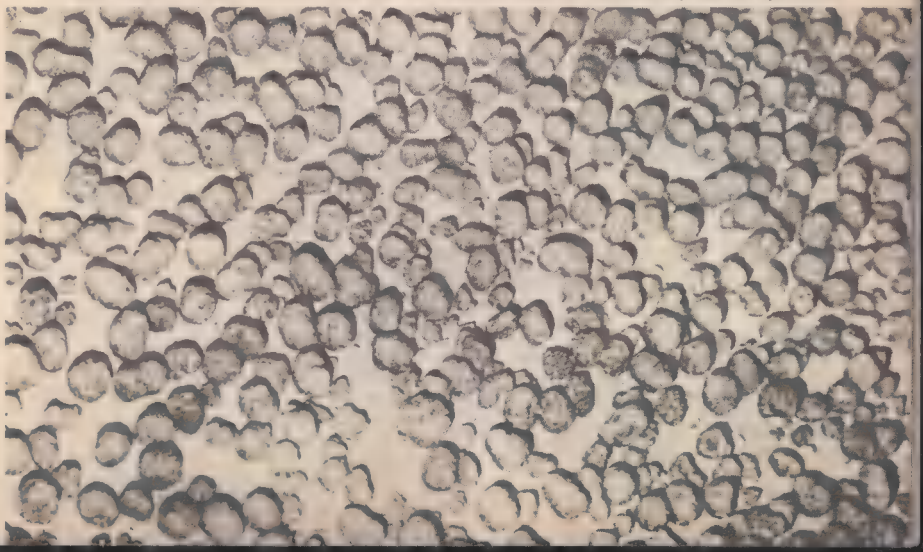
Ocean Systems has been pushing ahead a little faster. In 1964, Robert Stenuit and Jon Lindbergh spent 48 hours at 432 feet. In the early part of this year, the company expects to have divers reaching 1,000 feet.

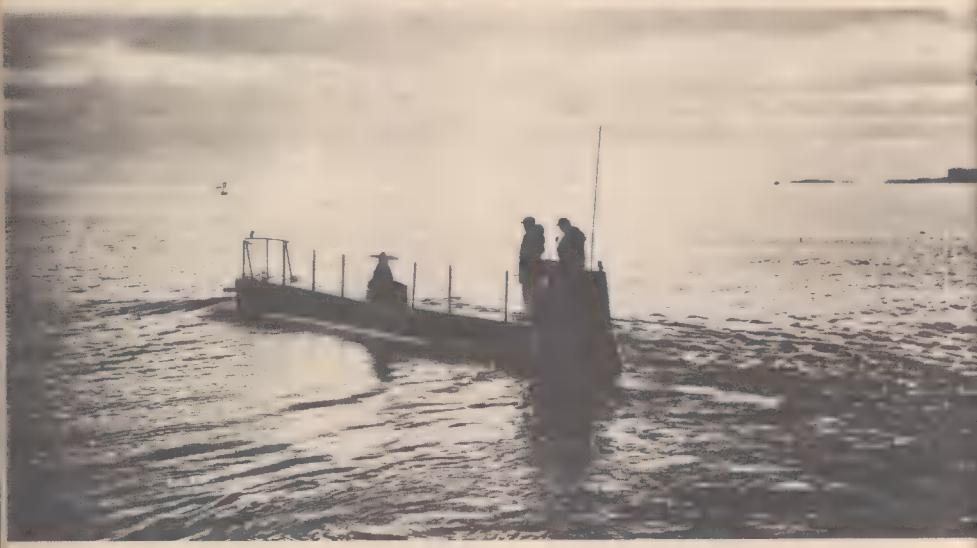
But it is the French who started the race and are still leading it. While Sealab II was getting so much notice, Captain Jacques-Yves Cousteau's men were spending three weeks at 330 feet off the French Riviera.

Most of the terrors of deep diving are in the very air that is breathed. Too much oxygen causes oxygen poisoning; nitrogen under high pressure causes narcosis or "rapture of the deep." So oxygen is reduced, and helium substituted for nitrogen. At extreme depths, helium

The riches

Manganese nodules, like these near Bikini, grow faster than we could use them. Getting them is another thing. Some are found in several hundred feet of water. Most are over 12,000 feet deep. They range up to several feet in diameter, 1,700 pounds.





is being replaced experimentally with neon, at a cost of $75 to $100 per minute.

Under high pressure, these gases charge the body fluids as carbon dioxide does champagne. If the pressure is suddenly released, the fluids bubble, just as champagne fizzes when the bottle is uncorked. This is the bends. Gradual, safe decompression by slowly raising the diver to the surface would take days at present depth limits. Instead, pressure chamber elevators whisk the divers to the surface where they undergo decompression on the deck of the tender or stay the night before being dropped to the bottom again the next morning. When they spend full time on the bottom, the divers live in what amounts to an enclosed bubble of their special air. Ocean Systems' underwater house is a heavy rubber sausage reinforced with nylon.

One of the richest rewards for the risks these men are taking could be sunken treasure. The Nassau Smelting and Refining Co., Tottenville, N.Y., estimates that since the year 1500 a million ships have sunk carrying one quarter of all the gold and silver ever mined. When we have learned how to find sunken *Threshers,* we should know how to find sunken treasures.

The surest, and at present, almost only sizeable mineral payoff from the ocean is oil and gas. Oil companies have been drilling in shallow water for years and are now steadily pushing out into deeper water. Their operations presently keep Ocean Systems in business as the industry's underwater plumber.

"By 1975," a report from the Batelle Memorial Institute says, "production of both oil and gas is

The subs

The Aluminaut (left), designed to reach 15,000 feet, undergoes trials at Groton, Conn. The motor-driven screw on the deck provides vertical propulsion. Twin arms reaching out from the bow pick up samples and put them in outside bins.

Captain Cousteau's Diving Saucer at work off California (right). Cousteau will design, and Westinghouse will build, a series of four Deep Star submersibles. One with a titanium hull is scheduled to reach 20,000 feet during the 1970's.

expected to be commonplace in water 1,000 feet deep." By 1990, says John Loudon, chairman of Royal Dutch Petroleum, "several oil fields" will operate in water 2,000 feet deep.

Another payoff that should surprise no one is the further exploitation of drowned beaches. During the Pleistocene, or glacial epoch, which ended around 11,000 years ago, the oceans were about 300 feet lower. Deposits on the shoreline or built up in river deltas then are now covered with water. Tin deposits of this type are dredged from the bottom off the Malay peninsula. Iron sands are taken out of Tokyo harbor. Other iron sand deposits exist off Alaska. Gold sands off the beaches of Nome and Juneau, where the gold rush of the 1890s took place, are being prospected by Shell. A Texan is pumping diamonds from the bottom off the southwest coast of Africa and getting five times as many diamonds per ton as others are getting on shore.

Yet these are not the new kinds of wealth we had been led to expect the sea to miraculously deliver. Recovery of dissolved elements is more like it. A typical happy statistic has it that a billion tons of something or other is dissolved in the ocean. What is left unexplained is that it is distributed through 335,000,000 cubic miles of water. Salt, bromine and magnesium are extracted. For other elements it costs more than it's worth just to pump the water. Where water is being pumped anyway, as in a desalination plant, some extraction may become worthwhile.

Out in deeper water lie the more tantalizing minerals, phosphorite

In Navy's Sealab II experiment, Tuffy the porpoise was delivery boy between the surface and the divers 210 feet below.

Curious fish watch aquanaut Berry Cannon inside Sealab II, where he lived for 15 days while working on the ocean floor.

The men

Divers who later formed Ocean Systems, Inc., anchor their rubber home in 430 feet of water off the Bahamas in 1964.

At a simulated depth of 650 feet, Ocean Systems divers prepare for a real 24-hour dive that was to be made off California.

and manganese nodules that sit on the ocean floor just waiting to be picked up. Phosphorite could be ground for fertilizer. Manganese is a valuable steel alloying element we presently import.

The nodules are the dung heaps of marine bacteria, according to the theory of Galen Jones, associate professor of biology at Boston U. The bacteria often attach themselves to inert objects like a shark's tooth or a whale's earbone and catch food passing by. Their food is organic material combined with metals. The bacteria consume the organic material and deposit the metal on their home, building up a nodule in onion-like layers at a rate of from four ten-thousandths of an inch to four-tenths of an inch in a thousand years.

Phosphorite nodules are found at the outer edge of the continental shelf and on off-shore banks. Our most promising deposits, says Dr. Maurice Ewing, head of Columbia U.'s Lamont Geological Observatory, is off southern California. In 1963, the Union Oil Co. had a lease on a phosphate area 40 miles off San Diego, but let it go. Mining seemed uneconomical. Besides, the area was dotted with live Navy shells.

Profitable mining methods may come out of a joint study being pursued by the U.S. Bureau of Mines, Lockheed, and International Minerals and Chemicals.

Farther out, usually in water over 1,500 feet deep, are the manganese nodules. Likely deposits are off the Carolina coast and much deeper in the mid-Pacific. They form slowly, but they cover such a wide area, says Dean Athelstan Spilhaus of Minnesota U.'s Institute of Technology, that they accumulate manganese faster than we use it. The manganese alone wouldn't pay for the mining, he says, but byproducts such as cobalt and nickel may tip the balance.

Engineer John Mero has championed the idea of harvesting the deposits with a huge suction dredge. One dredge would supply half the needs of the country. When will this happen? Ewing guesses that manganese "will probably be developed within one or two decades, as high-grade deposits on land become further depleted."

Remote in time

Even more remote in time, figures Ewing, are the chances of mining other ocean minerals such as Globigerina ooze for cement, and sulphides in the sediments of enclosed basins. Overall, aside from oil, James Stewart of the Scripps Institution of Oceanography does not see commercial mining operations that "are not a long way in the future."

Something similar might be said for fishing. The U.S. fishing industry has tremendous potential for improvement, simply because its state is so sad. Fish farming? It will take years for our methods to catch up to today. Our catch trails in a poor fifth after those of Japan,

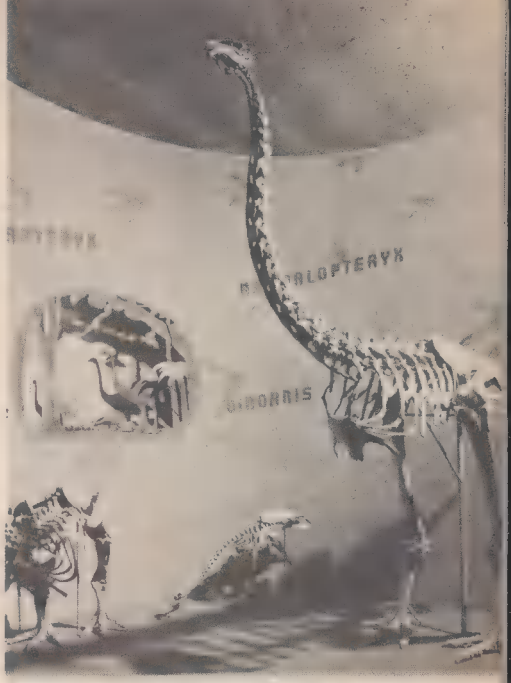
Peru, China and Russia. As the world catch was increasing by 60 percent from 1955 to 1962, ours actually declined, while our imports nearly tripled. Whether the cause is high prices resulting from the outmoded methods of a fragmented and unenterprising industry, or a public preference for red meat in the U.S., the tonnage of fish going to oil and animal feed now equals the quantity of fish eaten by humans.

We not only must compete with Japanese factory ships and Russian deep trawlers, but also with a Japanese daily fish forecast for the Pacific. Just catching up so that we can compete in our own market would increase our catch by one-third, says Ewing. Further "rational development" could double it in 15 years and quadruple our foreign ventures in ten. But, he warns, "Scandinavian, Spanish, French and German operators are also getting into the game."

Thus the opportunities of the ocean are more long range than short. *Barron's* expects five more years of study; five years to apply the results, then 50 years of exploitation. But even the most sober analysts will agree with Spilhaus, who says, "The sea's bottom is at least as interesting and certainly more immediately useful to mankind than the moon's backside."

"That shows how little you women know about electronics . . . up about six inches."

The bird that stood 10 feet tall



A moa skeleton rises above its contemporaries in Canterbury Museum.

by Roger A. Caras

HOW SPLENDID is isolation? In the case of natural history, it can be splendid indeed.

Consider the Galapagos Islands, an area with strange forms of life well known to every reader in the natural sciences. Or the Australian subcontinent, whose isolation gave enormous scope to the strange world of the marsupial and provides ecologists and taxonomists with problems for generations to come (See "Saved: Australia's Delightful Wildlife," Sept., '65).

But one of the greatest isolation stories of all concerns the strange flightless birds of New Zealand.

New Zealand's 105,000 square miles (that's two-thirds the size of California) have apparently been remote for a very long time. Although evidence that this small group of islands was insular before and during the Mesozic era isn't conclusive, it appears that this was so. There are no indications of a land connection and there is a marked absence of terrestrial vertebrates including dinosaurs in the fossil record.

When man came upon these, the most southern and western of the Polynesian islands, the only native mammal was a bat. Just as the ecological niches of Australia were filled by marsupial mammals, these niches in New Zealand were filled by birds, many of which could not fly. With no land predators, flight was not necessary. Evolutionary processes disposed of the unnecessary and energy-consuming function in

Notornis, long "extinct," was recently rediscovered. The Moa bird could be, too.

many of the native species.

The grazing animals of ancient New Zealand were, perhaps, the most wonderful birds of all for these were the great moas. There were six or seven varieties of moas but the mightiest of all was *Dinornis maximus*. Here was a bird that stood taller than any animal alive on this planet today with the exception of the giraffe and the African elephant. The leg bones of *Dinornis* were heavier than those of our largest draft horse. A moa 10 feet tall or more consumed as much fodder in one day as our largest bullock. Its gizzard stones were as large as soft balls and a single bird would carry around a bushel basket full. Here, indeed, was a wonderful bird.

The flightless ones are known as *ratites*, from the Latin word for raft *(ratis)*, referring to breast bones that are flat, unequipped with a keel that can support flight muscles.

It is not known for certain whether the moas and a number of the other flightless birds of New Zealand were descended from birds that could fly, or from birds that never had the power of flight, such as penguins. We do know that the moas were without flight for a very long time. Fossils have been found 75 feet down in the lava-baked red clay at the foot of Mount Horrible. That clay was laid down somewhere between two and seven million years ago.

No one knows when the last *Dinornis* died and we cannot know for certain if any of these 10-to-12-foot giants were seen by man, although the people who inhabited the islands of New Zealand before the coming of the Maoris in 1350 A.D. are known to history as the Moa-Hunters.

It is known that the Moa-Hunters hunted the *Megalapteryx* moas, birds no more impressive than a turkey. We do not know when these forest-dwelling moas died out. Indeed, we do not know for certain that they do not still exist in one of the many extremely remote valleys on South Island or on much smaller Stewart Island.

On a visit to New Zealand a couple of years ago, this author heard several stories about extant moas on Stewart Island. While there was no evidence at hand that would justify such an assumption, there was a marked persistence of the stories from people who should know. The moa should not be counted out just yet. There is still some looking to be done. It is a fair assumption, however, that any moas found alive

today would not be in the 10-foot-plus category of *Dinornis*.

Some moral support for the "moa-still-with-us" school is found in the rediscovery in 1948 of the flightless Notornis or takahe. Until a breeding pair and subsequently a small colony were found in remote Pyramid Valley a scant 18 years ago, the species was universally accepted as being extinct. Perhaps that does support the moa-now story, and perhaps it does not. It does show that New Zealand has secrets, however.

Impressive among New Zealand's other flightless birds were *Aptornis*, a three-foot-tall relative of the common woodhen, and *Cnemiornis*, a flightless goose. *Harpagornis*, a long-legged eagle with pitifully small wings, probably did fly to a limited extent. He was on his way to the flightless state when he inexplicably vanished, it may be assumed, forever.

Today the Notornis exists, along with the kiwi and the kakapo, to remind us of New Zealand's strange avian heritage. Now that these land-bound birds face the competition of introduced species, now that dogs, cats, and pigs roam the islands, they will probably vanish eventually as did the other species.

The kakapo is the world's only flightless parrot and had vanished for 50 years until found again seven years ago in South Island's west coast fiordland. The kakapo's status as a truly flightless bird, it should

Kiwi, New Zealand's symbol, typifies country's strange avian heritage. Females lay giant eggs almost a quarter their size. The flightless birds are nocturnal forest dwellers.

be noted, is open to question. It does have a slight keel on its breast bone and it can glide on a downhill run, or to descend from a tree into which it has climbed. It is a seriously endangered species and a great deal of effort is being expended in an effort to preserve this rare and interesting creature out of the past for as long as possible.

Kiwi S.O.S.

Truly flightless and also endangered is the living symbol of the New Zealand nation and people. The kiwi is a bird so associated with this tiny South Pacific nation that New Zealanders at home and abroad are inevitably called "kiwis," and take the nickname as a compliment.

The kiwi *(Apteryx)* is a strange little nocturnal forest dweller and is the only known bird with nostrils out at the end of the beak instead of back at the base. Its feathers are like hair, its sense of smell is extremely keen, according to reports, and its eggs are larger in proportion to body size than those of any other bird, by approximately 25 percent. Overall, the kiwi is chicken size, although a little chunkier in build. It is a slightly ridiculous-looking but fascinating bird that has survived into our time by great good luck.

New Zealanders are attempting to assure its survival for as long as possible, for scientific as well as esthetic reasons. As a New Zealand government pamphlet entitled, "KIWI S.O.S." put it:

"Please give the kiwis a break. Let us keep them with us on the mainland, not merely as a few survivors on offshore islands with their replicas on coins, trade marks, and advertisements."

Tracks on the ocean floor

The mystery had brewed for years. Strange animal burrows and tracks had been photographed on the ocean floor in the South Pacific, near Tahiti; in the North Atlantic and Indian oceans. Cameras had recorded the tracks on nearly every ocean bottom and under water to a depth greater than two miles.

The patterns began and ended abruptly. There were no traces leading toward their centers or away from their outer ends. One kind of track was a large spiral pattern one to six feet in diameter.

The answer appeared recently in a photo taken on the floor of the Pacific by Bruce C. Heezen and Donald W. Bourne of Columbia and Cambridge Universities, respectively. There was a giant Enteropneust or acorn worm, making tracks at a depth of 15,534 feet (3 miles).

Heezen and Bourne believe the photo is the first deep-ocean look at an ocean worm since the famed English ship, *Challenger*, dredged up three similar and damaged specimens in 1873. They were described as having "very lively colours." It took over 90 years to credit them with their lively tracks.

The group may be informal, but participants come prepared to tackle the task of thinking in a new style to produce new contexts, new solutions for old problems.

Ideas to order

ALASTAIR Pilkington of Great Britain conceived the idea for float glass while watching grease float on water as he washed the dishes. The invention, now licensed in the U.S., produces high quality finished plate glass by floating molten glass on a bath of molten tin; cuts costs by ⅓ and improves strength and quality.

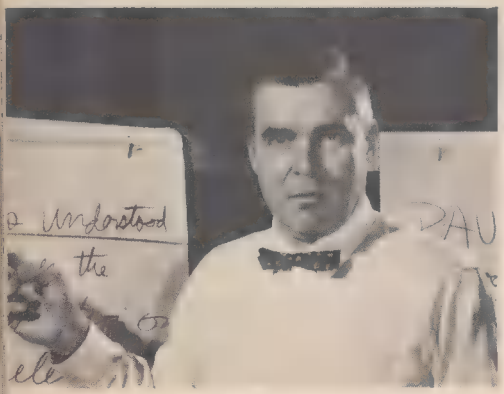
Pilkington made the connection between glass production and the seemingly irrelevant floating grease by "chance." A company in Cambridge, Mass., Synectics Inc., has devised a method for deliberately increasing the opportunity for these "chance" connections to happen. The company, consultants in the innovative process, teaches the method to small groups from such companies as Colgate-Palmolive Company, IBM Corp., Monsanto and Esso Research and Engineering Company.

Trainees bring real problems to the one week course and after learning the basic principles of the method, work together to solve problems.

A training group is divided into teams of from five to seven people. Each member takes his turn leading his team in problem-solving meetings.

The heart of the method is the repeated use of metaphors or analogies to provide new contexts for an old problem. For example, one team was trying to devise a new way to detect instantly flameout in a gas clothes dryer. The leader asked his team for strange examples (analogies) of flame. One response was plasma. The leader then asked the team to examine plasma. "What are its characteristics?" he asked. The following responses were noted on the large newsprint easel pads used in meetings:

- It is amorphous.
- It is ionized.
- Can be stable or unstable (candle flame is stable,



George M. Prince, president of Synectics, seeks ways to enhance creative thought.

explosion is not).

- It converts energy to heat.
- And light.
- And sometimes sound.
- Conducts electricity because ionized.

The leader: "How can we use this stable and unstable idea to help solve our problem?" He was trying to force a connection.

Member: "I don't see how to use that, but I can use the ionized things."

Leader: "How?"

Member: "When the gas in the dryer is burning, it will conduct a current. When out, it won't. A flameout would break a circuit."

The team took the seemingly irrelevant material developed from the analogy and forced a connection to solve the problem.

Synectics uses three different types of analogy to develop material for possible use in connection making. The above is called ■ Direct Analogy—an example that is somehow related to an element of the problem (plasma is a special example of flame).

Personal Analogy requires a member of the team to identify with an element of the problem. The leader might have said: "Tom, you are a drop of gas. Your only hope of immortality is to burn. Just as you get to the opening, the flame goes out. How do you feel?"

The third type of analogy is called Symbolic Analogy. It attempts to capture the essence of a key word in the problem. The leader might ask: "What is the essence of flameness?"

Member: "Ghostly thereness."

Leader: "How so?"

Member: "A flame seems unsubstantial and wavering but if you put your finger in its territory—boy! It's there."

This analogy led to the idea of using the flame as a wall. A jet of gas could not penetrate the flame wall but could depress a sensor on the other side in a flameout.

The common purpose served by the analogies is to make ■ familiar problem seem strange. When viewed in a strange way, new lines of speculation are suggested: one may lead to a new solution.

Characteristically, a Synectics meeting repeatedly generates new analogies and then tries to make them useful.

Synectics Inc. was founded in 1960 by two men who formerly worked in the Invention Design Group of Arthur D. Little, the Cambridge industrial research firm.

William Gordon has put Synectics' principles to work, holds many patents.

William J. J. Gordon and George M. Prince, both now in their middle forties, had both been fascinated for years by the peculiarly elusive nature of the creative process. Together they designed experiments to attempt to understand and isolate the steps one's mind goes through to develop ■ new idea.

Their main research tool has been the tape recorder. They have taped problem-solving meetings to analyze the behavior of participants and discourage destructive behavior.

For example, one universal behavior seems to be negativity. Everyone tends to attack a new idea. Gordon and Prince recognized that eventually an idea must be strong enough to stand up under criticism. Initially, though, team members must try to build into the new idea the strength to meet their own objections.

Synectics' procedures continue to develop as the body of knowledge about the creative process increases. Gordon and Prince say that they can now teach in a week more than they could in five weeks in 1960.

Heart attacks blamed on hemoglobin

THE culprit in six out of 10 fatal heart attacks may be an abnormal kind of hemoglobin, the red pigment that carries oxygen in the blood. Two medical researchers have identified the substance and say that it carries oxygen as efficiently as ordinary hemoglobin but does not release the oxygen. This causes oxygen starvation of the tissues.

If this starvation affects the heart, the muscle can die and heart failure result, according to Dr. Robert S. Eliot and Dr. Hiroshi Mizukami of the University of Minnesota. They discovered the substance in three young women who had the symptoms of heart trouble that usually indicate blockage of one of the heart's vessels. Subsequent studies found the so-called "stingy" hemoglobin in eight other heart patients, but not in a dozen normal persons.

The doctors are now investigating to see if the abnormal hemoglobin, or a tendency to develop it, is inherited or if the component is acquired.

Ivy-draped gate leads to Quadrangle, a landmark of 142-year-old Rensselaer Polytechnic.

Old R. P. I.

From the hills above Troy, N.Y., Rensselaer Polytechnic Institute looks across the winding Hudson at a continent that was barely known the day it was founded.

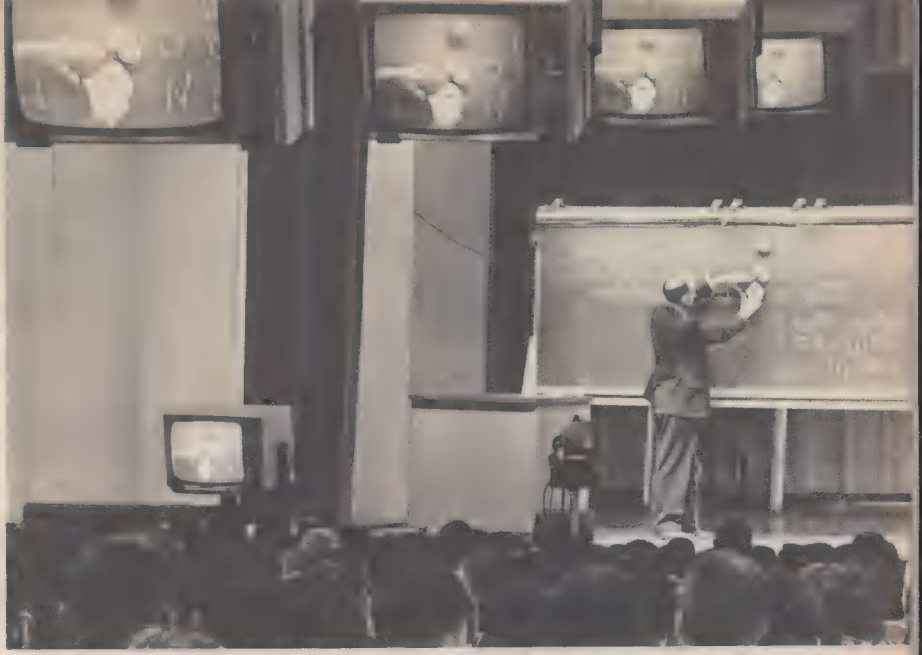
The nation's oldest technological university began modestly in 1824, training people to apply "science to the common purposes of life."

Today, it still does that—but on a handsome campus combining ivy-covered walls and spanking new buildings housing some of the country's finest research facilities.

In its long history, Rensselaer (pronounced REN-se-ler and named after Stephen Van Rensselaer, an upstate philanthropist) has pioneered in scientific education. R.P.I.'s Senior Professor in its early days, Amos Eaton, found he could generate the greatest enthusiasm in students by having them learn through experiment—one of the tenets of modern education.

Rensselaer grew with the industrial revolution of the 19th century. It was the alma mater of some of America's most distinguished civil engineers of that time, including the builders of the Brooklyn Bridge, the Pennsylvania Railroad and the first Ferris wheel, G.W. Ferris.

Now it has a student enrollment of over 5,200 in Schools of Science, Engineering, Humanities and Social Sciences, Architecture, and Management, plus a Graduate School.

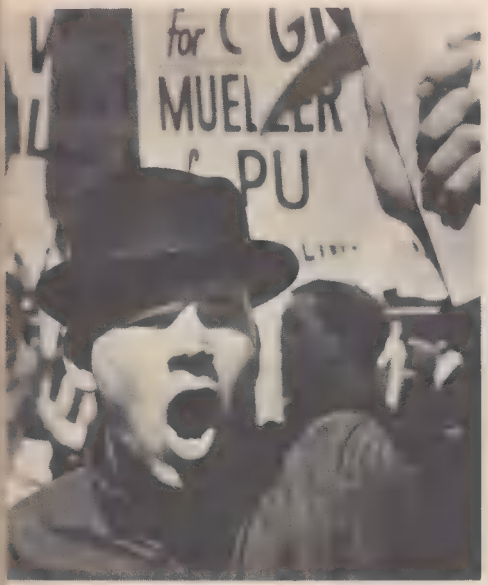


Latest teaching methods at Institute today include this classroom wth TV monitors

—and new

Mary Anne Rathbun, a daughter of an R.P.I. alumnus, is one of 131 women students.

Carol A. Roman, a sophomore, is from Roosevelt, N.Y. Student body represents almost all states, over 24 foreign nations.



Students campaign vociferously in annual Grand Marshal Week. R.P.I. also approves their political activity "within guidelines."

WHO studies what at R.P.I.? During 1964-65, 19 percent of undergraduate work was in the humanities and social sciences; 23½ percent in engineering and 47 percent in science. Architecture, management and ROTC accounted for the rest.

Rensselaer still graduates more engineers than anything else, however. In the year ending last June, the School of Engineering awarded 408 bachelors' degrees, 138 masters' degrees and 39 doctorates. Nine departments taught 269 different courses (77 of them undergraduate), with emphasis on electrical, materials, mechanical and chemical engineering and nuclear engineering and science (a new field).

The Institute inaugurated a significant change in its engineering program two years ago. After three years, students may choose between a final year of study leading to a B.S. or a two-year course leading to an M.E. In keeping with that change, the American Society for Engineering Education recently recommended that the first professional degree be a master's one, not a bachelor's.

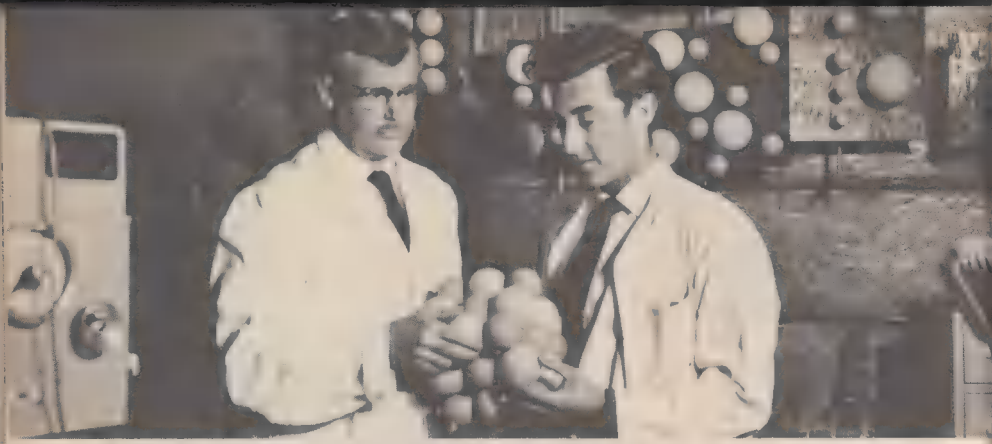
In other areas, R.P.I. has made some shortcuts. With nearby Albany Medical College, it has set up a biomedical program leading to B.S. and M.D. degrees in six years.

That program epitomizes the growing need for interdisciplinary education, for example: intensive biology and electronics for physicians. It's a concept R.P.I. heartily supports.

R.P.I. stresses "interplay" between science and society. This is language and lit class.

Graduate physics and mechanics labs are housed in $9 million Rensselaer Science Center.

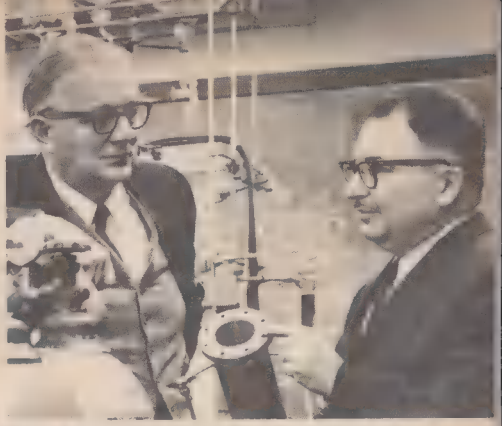
Newest addition is Materials Research Center and Engineering-Science Research Building.



Dr. George J. Janz and aide teach chemistry with help of luminescent atomic structures.

Cobalt experiment is one of many R.P.I. studies using its $3 million linear accelerator.

Dr. Richard G. Folsom has been president of R.P.I. since 1958, organizing Institute along lines of a technological university.



Two faculty notables: Dr. Paul Harteck, physical chemistry, left; Dr. Seymour Dondes of chemonuclear research laboratory.

As at other leading technological universities, teaching and research go hand in hand at R.P.I.

At last count, the Institute was busy on 98 sponsored research projects with a total gross funding of $5,700,000. The Atomic Energy Commission, NASA and the National Science Foundation are sponsoring most of the projects.

Faculty and students of the School of Science do research work in biology, chemistry (notably analysis of color production), geology, mathematics, mechanics and physics. The Engineering School has been working especially in materials research and in projects evolving around the most powerful linear accelerator in a U.S. school.

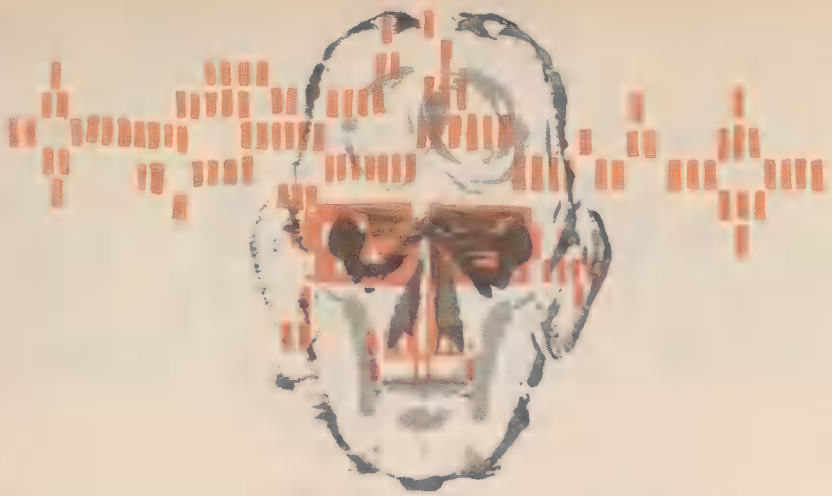
R.P.I.'s research work has grown since it created a Graduate School and, in 1955, the Rensselaer Center for Graduate Study at Hartford, Conn., which awarded 102 masters' degrees in 1964-65.

Many nationally-known teachers are on the R.P.I. faculty. Perhaps the best-known is Dr. Robert Resnick, co-author of a physics textbook used in over 400 colleges and universities in the U.S. and abroad.

The educational emphasis at Rensselaer is one that America's science universities increasingly stress—what science means to man. "New knowledge," says Dr. Folsom, "is not enough. It must be considered with judgment and wisdom."

This is the fourth in a series on America's top science schools.

Athletically, R.P.I. is strong in hockey, unique in football. Here grid team celebrates recent first victory in six years.



The computer that psychoanalyzes you

by Magoroh Maruyama

On the television screen connected with the computer, this writing appeared:

"How can I help you?"

Mr. Craig, a volunteer in the experiment, sat at the typewriter, also connected with the computer, and typed out: "I am sick and tired today."

In a fraction of a second, a new writing appeared on the screen: "Do you have any idea why?"

Mr. Craig answered: "Yes, I am old."

The dialogue between the computer and Mr. Craig continued:

"Please go on."

"I seem to have lost interest in everything."

"Tell me more about such feelings."

"I have some idea why I feel this way too."

"You have?"

"It seems that I miss having a family."

So goes one of a series of experiments designed by Dr. Kenneth Mark Colby of Stanford University to let a computer act as an assistant to a psychiatrist.

The principle used is simple. Inside the computer each of the 26 letters of the alphabet is converted

to a certain numerical code. Words appear as a string of numbers. At the beginning of the experiment a list of key words is fed into the memory of the computer. A set of instructions as to how to react to certain key words or combination of key words is also fed into the computer. When a "patient" types a sentence, the computer identifies the key words, forms a meaning, and prods conversation further. With this principle, the computer could not give advice or an answer, but it could help a patient express himself and formulate his problems.

Mental hospitals throughout the nation are understaffed. Many of the patients seldom have opportunities to talk with a psychiatrist. Many of those who would get well if treated intensively are left to vegetate in hospital wards, and eventually may become so adjusted to hospital life that they are incapable of living outside.

Mechanical helper

A solution must be found, and Colby is experimenting with one approach. Psychiatrists should limit their efforts to severe cases. Routine psychiatric sessions would be handled by a computer. A large computer like an IBM 7090 would be able to handle dialogues with 200 patients simultaneously and individually by means of high-speed time sharing. A psychiatrist would scan the printed output of the dialogues as they develop, and intervene in the session when needed.

Several computer programs would be prepared: one to talk about family relations; one to talk about sex, and so forth.

Time sharing

A computer can run several programs simultaneously by high-speed time sharing. The psychiatrist would assign an appropriate program to each patient. The computer dialogue might stimulate curiosity in patients who have become "unmotivated." They might even become motivated to learn to type and spell in order to talk with the computer.

Colby's dream is great but not impossible. He is now experimenting with computer dialogue with one person at a time. His computer program, called "auto-couch," has many bugs and often produce silly results. But it does accomplish astonishingly much. At the present, all "auto-couch" does is to prod and steer conversation. But in the past Colby produced a computer program that detected mental conflicts and performed neurotic distortions. If this feature is incorporated in the "auto-couch," the computer can detect mental conflicts and register them.

Colby and his assistant, John P. Gilbert, laid down rules of neurotic distortions to be fed into the computer. They tape-recorded therapy sessions with a neurotic woman patient, and selected some of her conflicting thoughts, for instance "I

hate my father" and "I must like him." These were punched on IBM cards. The cards, together with the rules of distortion, were fed into a computer to see how the machine would handle the conflicts. The aim was to produce a set of rules to make the computer process the conflicts like a real doctor, and to try out new therapies on the computer "robot."

Rules of distortion

Colby based this experiment on a few basic rules of distortion that often occur in the human mind. In the case of the woman with two conflicting thoughts, "I hate my father" and "I must like my father," her mind tries to resolve the conflict by distorting one of the two thoughts. "I hate my father" may become "I hate Joe." Or it may become "My mother hates my father," or "My father hates me," or even "I love my father," or "My father loves me." These types of distortion have names in psychology but can also be stated in grammatical terms:

Original thought: "I hate my father."

Distortion	Psychological term	Grammatical rule
I hate Joe.	deflection (displacement)	Change object.
I like my father.	reaction formation	Reverse verb.
My mother hates my father.	projection	Change subject.
My father hates me.	projection	Exchange subject with object.
My father loves me.		Exchange subject with object, and reverse verb.

Within certain limitations these grammatical rules can be handled by the machine. A dictionary of key words such as "father," "mother," "love" is given to the computer memory. In the dictionary, words with opposite emotions like "love" and "hate" are assigned opposite numerical values. Words with different emotional strength like "detest" and "dislike" are also given different numerical values. With a list of synonyms and antonyms, the computer can reverse the verb, change the object or perform other required operations. Colby uses seven types of distortion in his neurosis program.

Key word clusters

Input sentences are registered into the memory and sorted out into clusters according to shared key words. Within each cluster, the sentences are arranged from the strongest to the weakest. The strength of a sentence is determined by its grammatical form and by the words used. The program picks up

Love, hate and irrationality can be put into a computer program.

the most "urgent" cluster and examines conflicts in it. Sentences that have no strong conflicts with other sentences in the cluster are printed out, and their "emotional charge" is reduced by 90 percent. A conflict between two strong sentences is considered "pathogenic" and a distortion is formed. The type of distortion selected depends on the "danger level" and "self esteem," which are quantities computed at each step. When the distortion does not produce an "acceptable" or conflictless thought, stronger distortions are tried one after another until an acceptable thought is produced and printed out. The type of distortion that proves successful is given a larger chance to be used later. This approximates the tendency of people to repeat a successful defense mechanism over and over.

Opens new avenues

All this is ingenious. The program resembles the actual neurotic in many ways. It is far from being perfect. But it opens a new dimension in computer application.

Computers have been used for a variety of purposes: making cross-references, solving puzzles, playing chess, proving mathematical theorems and many more. Each of these applications has its own rationale. A computer may play chess by setting up a series of intermediate goals such as taking the enemy queen, selecting a few rules of thumb in strategy, calculating the gains and risks a few steps in advance, and modifying the strategy according to the past record of success and failure. The rationale in these cases has been based on a rational procedure.

Irrationality

There are some who have ventured to program irrationality into computer programs. One was Robert P. Abelson of Yale. He worked out a program that made rationalizations when a conflict was found within a sentence, for example "My good friend John has stolen money", or "My experiment turned out to be a failure". The program generated a thought like "Failures enrich my understanding" and transformed the original sentence into "My experience enriched my understanding." Like Colby's program, Abelson's program had a feature of successive distortions when one distortion did not produce an acceptable result. But while Colby focuses his attention on conflicts between sentences, Abelson's interest remained within a sentence.

Colby's program has the additional feature of taking emotional elements into consideration, such as

But a computer can be outwitted by jokes, lies and insinuations.

"self-esteem" and "danger level." But use of emotional states in a computer simulation of mental process is not Colby's monopoly. John C. Loehlin of the University of Nebraska programs emotional development. His "Aldous" interprets and reacts to a series of given situations according to its "emotional makeup" and "past experiences," and develops an attitude and a behavior pattern. Aldous also has emotional conflicts, though they are much simpler than those of Colby's computer. Loehlin gave various "personality characteristics" to Aldous, such as hesitant, decisive, radical, conservative and abstract, by changing the reaction level, amount of influence by the past memory and other numerical values. Loehlin also wrote a program to let two Aldouses interact with each other, giving them various initial conditions and personality characteristics.

Not unique

No single feature of Colby's neurosis program is unique. Recognition of key words in sentences is a widely used technique. Robert C. North at Stanford University used it in his analysis of political texts, and John A. Starkweather of University of California Medical Center used it in his question-and-answer program.

But Colby is the first to combine these ideas in a single program to perform distortions depending on the emotional condition influenced by immediately past mental activity when conflicts are found between different sentences by means of key words.

"But the context my neurosis program could handle was not wide enough for actual life situations," says Colby. "There were many aspects of human interaction which were beyond the capacity of my program to simulate."

Its drawbacks

Most obvious is its inability to handle nonverbal cues such as gesture, posture, facial expression, tone of voice and movement. To overcome this shortcoming, Colby devised the numerical values such as danger level, self esteem, excitation level and pleasure level, which are computed at each step according to a pre-set formula. These numerical values, printed out with each verbal output, are substitutes for the nonverbal expressions of the computer.

Another problem is the inability of the program to recognize lies, jokes, metaphors, sarcasm and insinuations, and its inability to distinguish encouragement from discouragement, insult from praise, or accusation from question.

The third limitation is its lack of "temporal depth" or "life history." All "thoughts" are present thoughts, and the solution of their conflicts are sought on the level of the present only, ignoring past influences, future perspectives and goals. The only time-element incorporated is the cumulative influence of emotional states and emotional discharge, and the selection of the type of distortion dependent on them.

How to weigh emotion

Then there is certain arbitrariness in the program. For example, when a thought is expressed, 90 percent of its emotion is discharged. We do not know how to measure emotion, and even if we did, we would not know whether such a fixed percentage is adequate.

In spite of these problems, many unprecedented features are accomplished in the neurosis program. Among them is detection of conflicts between thoughts expressed in grammatically simple forms. This feature can be added to "auto-couch." Then "auto-couch" will be able, not only to prod and to listen to clients, but also to identify some of their problems and report them to a human psychiatrist.

It may be quite a while before Colby is able to put two hundred psychiatrists' routine work into a computer. But he may soon be able to put into a computer a few psychiatric assistants with certain specific tasks.

All photos Three Lions

Looking like an early version of Batman, a figure crouches in what Leonardo da Vinci thought a plane should look like. The machine was called an ornithopter. A wooden frame, two wings and a series of pulleys and a windlass made the machine "fly."

Leonardo da Vinci's Batman

He foresaw the helicopter, the airplane, the machine gun, the parachute and air conditioning, just to name a few items. And in many cases he built actual, working prototypes of his inventions.

It's not exactly news how fertile Leonardo da Vinci's scientific mind was. But a unique sample of the artist's universal genius, now being viewed by thousands in the U.S., serves as a timely reminder of the true unity of the so-called "two cultures." The reminder comes in the form of a touring exhibition of models of da Vinci's inventions commissioned by I B M for its Department of Arts and Sciences.

They were constructed by Dr. Roberto Guatelli after years of study and research on Leonardo's blueprints, some of which reached the construction stage in Leonardo's time.

How did they, or do they, work? In 1952, at least, one of them worked very well. Technical students made a parachute exactly to da Vinci's specifications. A life-size doll and the parachute were dropped from a 150-foot church steeple. The duration of the descent was five seconds.

Leonardo's ornithopter, or flying machine (above), was the most spectacular of his inventions; if it didn't fly, it was closely copied by early 20th-century aviators.

Four groups of models are being shown for three weeks at a time in museums and civic centers. Those interested can write IBM's Department of Arts and Sciences, 590 Madison Ave., New York, N.Y.

Below: The man who brought Leonardo's inventions to life, Dr. Roberto Guatelli, right, checks blueprints in his workshop.

Above: This gun was discharged by water flowing into the barrel, kept hot by live coals, which turned water into steam.

A sort of early model T, this is a model of the earliest known design for a self-propelled vehicle. It was spring-driven and had an elaborate system of gears. Dr. Guatelli, shown with the model, studied Leonardo da Vinci's blueprints for months to bring them to life.

Leonardo specified roller bearings to reduce the friction of a turning axle, in this vehicle. Though he lived in the Middle Ages, he was as versed in physics, hydraulics, optics, armaments and mechanical engineering as many technicians of centuries later.

Dr. Guatelli made models with help of assistant, Herbert Pederson, with whom he studies a drawing above. Dr. Guatelli supervised construction of Leonardo models in 1930's, but they were destroyed in World War II. He began making new ones thereafter.

The author had time to grow a beard and dwell on the leisurely side of life while crossing the Pacific at six knots. Here, back again, he tells why he thinks science will someday make life less hectic.

THE HUGH DOWNS COLUMN

Let's invest in buggy whips

TIME: The future. Place: A driveway outside a home somewhere near the sea.

Jim Brown's wife and daughter climb into the back of their buggy while he checks the harness and traces. Then he swings up into the driver's seat beside their son who's riding shotgun, flicks the horses lightly with the buggy whip and jogs off with his family to the beach.

The future? Why not?

Many of us look at the future wrong.

The last two generations have shown a curious tendency to speculate about the future merely in terms of extrapolating trends of technology: since more and better balanced nutriment is packed into foods today, the food of the future must be in pill form; with the skyscraper a reality now, the buildings of the future must rise to super heights and be starscrapers; with communications technique seeping into our private lives more and more, the future must surely have a "Big Brother" watching our every move.

Or there's been the gloomier assumption that the future holds the ultimate bomb and a flashbulb finale for everything.

There are dangers, no doubt, but there are surely also blessings ahead of us.

Ever since man freed his forelimbs from the task of walking and turned them to manipulating the world around him, he has exercised

his mental machinery to amplify e v e r y t h i n g about himself—his physical strength through leverage and power machinery, his stored knowledge through pictures and libraries, his eyesight through telescopes and microscopes, even his calculating ability and other skills through computers.

All these developments have been unfolding at an accelerated rather than a steady rate.

Too swift

Can progress be too swift? Is it time the alarm was sounded?

The answer is yes only if we lose control of our progress and the powers we've developed. But today's men of vision do not think we have lost control of either.

For this reason, they believe it is wrong to assume that the future will trap us into simply more speed, more dizzying heights, more horsepower, more traffic and congestion, and more push-button living.

They see on the other hand, more leisure time, more perspective and insight into the problems of progress and of their solutions. More choice of pace, more freedom from drudgery, more active hobbies and personal projects, and more freedom from mass production and conformity.

When Henry Ford first put the automobile within reach of the average wage earner, you had your choice of any color you wanted so long as it was black. Now, with a computerized assembly line, you not only have a wide choice of colors but can order a car with a fantastic amount of personalization.

I stood on the assembly line at a Chevrolet plant in Michigan at the point of mating chassis and body and saw how the intricate computerizing plan made possible a combination of choices that might be repeated only once in 500 cars—in color and upholstery, between automatic or stick shift and four or two doors, in factory-installed accessories (such as radio—with or without station seeker), tire types and power systems.

Peer into the future along these lines and you'll see a staggering degree of mass-produced personalization in the foreseeable future.

Dr. Thomas Paine of the organization, Tempo, and Jack White, a transportations systems designer for General Motors, both feel that greater variety will play such a part in the future that our lives will be enriched by a greater freedom of choice rather than by the imposition of planning by government or social or industrial agencies.

Time for the soul

In other words, technology carries with it some by-products just beginning to be realized: increased leisure does not mean more time in the tavern, as Voltaire thought. It means more time for the soul, for planning one's individual destiny, for involvement resulting in better civics and government, for heightening individuality.

We won't simply travel faster, we'll have more choice of speeds.

Cooking over a fire raised on a stone platform must surely predate the written word. But now people with the most modern gas, electric or electronic cooking devices build stone barbecues in their backyards and return to the primitive way of preparing food whenever they get the chance.

This is not a rebellion against technology. It is rather an opportunity provided by the increased leisure time technology makes possible. If a man still had to work 70 hours a week, you would not find him building or cooking over a barbecue pit.

It has been since the most modern powerful hunting guns came on the scene that archery has had its fantastic upswing. More bows and arrows flourish now in the United States than could be found in England during the time of Robin Hood.

Fast or slow

I myself enjoy slow speeds more now because of the high speeds reached by man. While it is great to cover distances at 550 miles per hour in a commercial jet plane, it is possible to comply with a turnpike speed limit of 60 and enjoy driving across this nation. And (to cite a broader base for personal perspective) while I have been privileged to fly the hottest new military jet fighter planes, such as the Mach 2 F-104, I was also greatly pleased and in no way impatient to be able to cross the Pacific Ocean in a small boat at an average of six knots, which is about seven miles per hour.

The old Colt Single Action Army was well known to collectors of early American handguns. Produced by Colt from 1861 to 1936, it became an antique of value as soon as it was discontinued. Right after World War II, Harry Lidstone, an officer of the company, assured me that Colt would never reissue this model. He was telling the truth at the time. It was the intention of the Colt Company never to revive the SAA, but a change of management and pressure of circumstance triggered by TV shows and buffs of the Wild West caused Colt to reissue the model. Now you can buy an authentic but new Colt Single Action Army from almost any gun dealer, besides a great variety of front-loading and muzzle-loading firearms, including the famed Kentucky long rifle, all new but just like the old ones.

Today, you can purchase build-it-yourself harpsichords and spinning wheels. Why not in the future build-it-yourself life-size and workable models of any classic car ever built? Or for the amateur archaeologist, kits for constructing authentic ruins made of lightweight and dura-

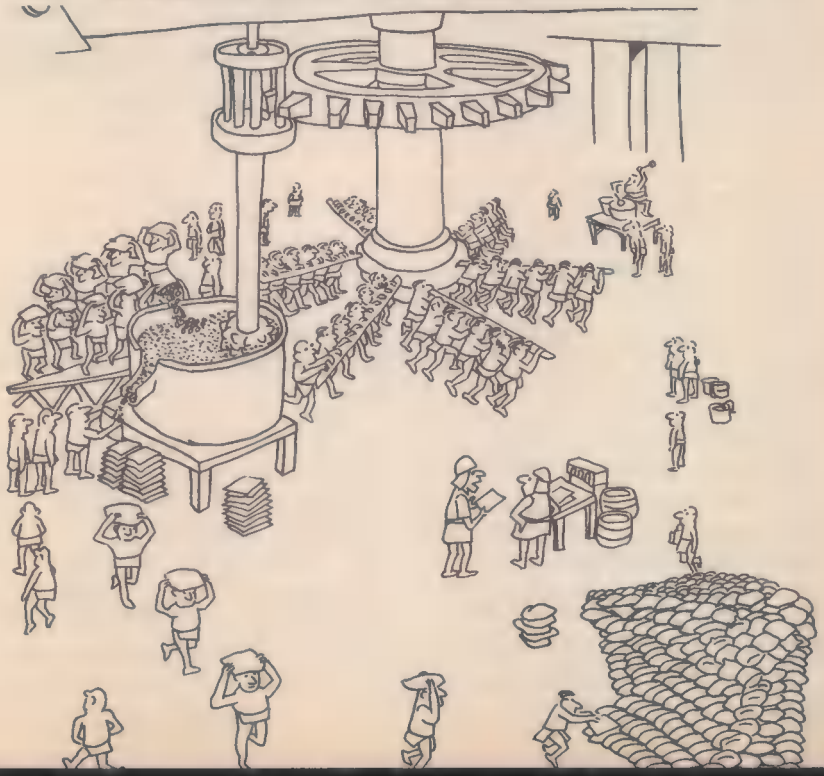
ble plastic with authentic coloring and texture of the world's great ruins—sort of a ruin-it-yourself project?

The future seems to lie, not ahead as Mort Sahl has said, but all around, in the increasing variety it spawns. We won't simply travel to places faster, we'll have a wider choice of speeds and modes of travel; we won't only live longer, we'll have a greater variety of ways of life; we'll not merely have more time for hobbies, we'll have myriads of possible hobby projects to choose from; we won't find a faster and faster pace but rather the choice at elected times between rapid personal progress and the healing tempo of some chosen backwater of time where prudent conservation measures have assured the continuance of songbirds and horses.

You will be able to hitch up a rig like Jim Brown's to a pair of Appaloosas or Arabians and clip out to the forest preserve where the air is pure and clear just as it is in the industrial sections of Megalopolis, where by then air pollution control will be a reality.

Buggy whip stock will be on the rise.

"The trouble with automation is it increases the need for men."



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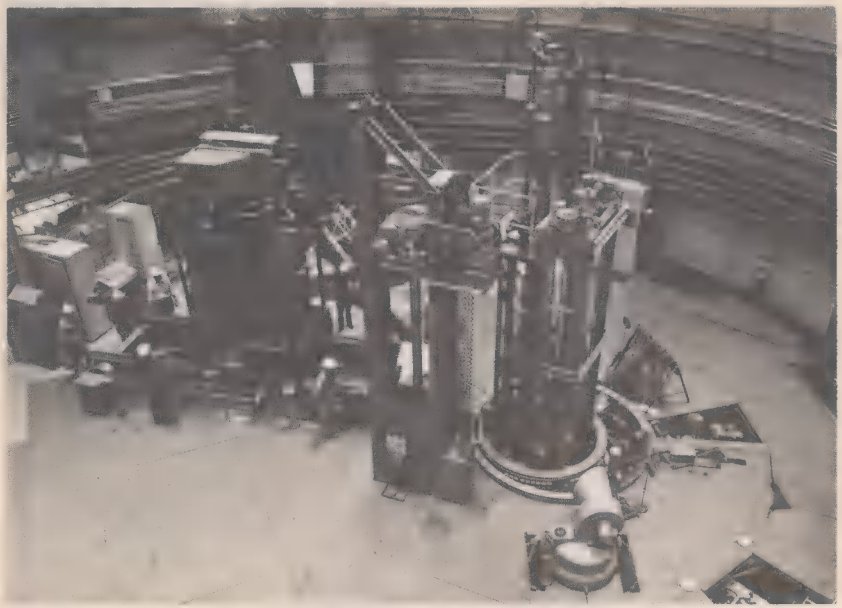

Mechanisms in new Argonne National Laboratory breeder reactor handle fuel. Primary reactor components are in a sodium-filled tank, 26 by 26 feet, below the floor.

How breeder reactors work

What's a breeder reactor? How does it work?

Uranium-235 is a practical nuclear fuel. That is, slow neutrons will cause uranium-235 atoms to undergo fission (break in two) and produce more slow neutrons which will bring about further atomic fission and so on. Uranium-233 and plutonium-239 are practical nuclear fuels for the same reason.

Unfortunately, uranium-233 and plutonium-239 exist in nature only in the barest traces, while uranium-235, though it does exist in appreciable quantities, is still rather rare. In any sample of natural uranium, only seven atoms out of a thousand are uranium-235. The rest are uranium-238.

Uranium-238, the common variety of uranium, is *not* a practical nuclear fuel. It can be made to undergo fission but only by fast neutrons. The uranium-238 atoms that break in two produce slow neutrons and these do not suffice to bring about further fissions. Uranium-238 can be compared to damp wood which may be set afire but

will eventually fizzle out.

However, suppose uranium-235 is separated from uranium-238 (a rather difficult job) and is used to set up a nuclear reactor. The uranium-235 atoms that form the fuel of the reactor undergo fission and send out vast myriads of slow neutrons in all directions. If the reactor is surrounded by a shell of ordinary uranium (which is mostly uranium-238), the neutrons entering that shell will be absorbed by the uranium-238. The neutrons cannot force the uranium-238 to undergo fission but they will bring about other changes which, in the end, will produce plutonium-239. If this plutonium-239 is separated from the uranium (a rather easy job), it can be used as a practical nuclear fuel.

A nuclear reactor that breeds new fuel in this manner to replace the fuel that is used up is a "breeder reactor." A breeder reactor of the proper design will produce plutonium-239 in quantities greater than the uranium-235 consumed. In this way, all Earth's supply of uranium, and not just the rare uranium-235, becomes a potential fuel supply.

Thorium, as it occurs naturally, consists entirely of thorium-232. This, like uranium-238, is not a practical nuclear fuel, since it requires fast neutrons to make it undergo fission.

However, if thorium-232 is placed in a shell around a nuclear reactor, the thorium-232 atoms will absorb neutrons and, without undergoing fission, will eventually become atoms of uranium-233. Since uranium-233 is a practical fuel which can be easily separated from thorium, the result is another form of breeder reactor, one which makes the Earth's supply of thorium available as a potential nuclear fuel.

The total quantity of uranium and thorium on Earth is about 800 times as great as the supply of uranium-235 alone. This means that the proper use of breeder reactors could increase Earth's potential energy supply through nuclear fission power plants 800-fold.

—Isaac Asimov

After someone explained the continental drift theory to me, the evidence on a map did seem persuasive. Is this theory a valid one?

Research in the field of earthquakes has undermined the theory of continental drift, which suggests that modern continents drifted away from a large "supercontinent" through movements of the earth's crust.

In a computer analysis of 1,500 earthquakes, Dr. Lynn R. Sykes, a geologist with Columbia University's Lamont Geological Observatory, plotted an accurate position for the focus of each quake. He found that earthquakes along certain island arcs in the Pacific Ocean and Caribbean Sea occur in well-defined continuous surfaces slanting from the ocean bottom through the crust and as much as 400 miles into the

earth's mantle, an 1,800 mile-thick layer of rock below the crust.

Supporters of the continental drift say that the continents move sideways as a result of differential movement of the thin crust with the underlying rock. The driving force proposed involves slow "convection currents" of hot, plastic rock in the mantle. As the currents rise and move to the side, they drag on the underside of the crust, thereby moving it with the current flow.

A sharp curvature in the top of a surface near the Tonga-Fiji Islands, duplicated in a closely related ocean-bottom trench, continues through the whole depth of the surface, Dr. Sykes indicated. He said it is unlikely that the distortion at the rock surface could result from crustal movement only.

"If the curvature of the northern end of the Tonga trench is a result of continental drifting or some other type of large-scale displacement," he said, "then this deformation must have extended to a depth of at least 650 kilometers (400 miles)." The crust of the earth is only about 25 miles thick under the continents and is only three or four miles thick under deep oceans.

Dr. Sykes noted that in three areas studied—the Tonga-Fiji region, the Kermadec and Kuril-Kamchatka island arcs in the Pacific and the Lesser Antillean arcs in the Caribbean—deep oceanic trenchs were associated with island arcs. In each case, a zone of intense seismic activity was located beneath the side of the trench closest to the islands and extended downward at an angle under the related island arc.

"The Tonga and Kermadec arcs," he pointed out, "are two of the most seismically active regions of the world for shallow earthquakes. In addition, about half of the world's very deep earthquakes occur in the two arcs."

The earthquake readings were taken from a network of four new seismograph stations which recorded shocks with accurate determinations of deep and shallow quakes.—*J. R.*

Recently, I heard of an insect juvenile hormone that was used as a pesticide. Could you explain what it is and how it works?

A juvenile hormone interferes with normal sexual development of an insect. It implies that a new principal of insect control may be forthcoming.

Dr. Karel Sláma and Prof. Carroll M. Williams of Harvard University's Department of Biology discovered that American newspapers, magazines and other paper products contain a substance quite

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This new regular feature of *Science Digest* will attempt to answer questions about the how's and why's of science. Send your question to Please Explain, Science Digest, 1775 Broadway, New York, New York, 10019.

lethal to many European insects.

The use of juvenile hormone was first suggested by Prof. Williams ten years ago. The idea is based on a phase in an insect's life when he must stop secreting juvenile hormone in order to transform into a mature, reproductive adult. At that stage, the insect is extremely sensitive to chemicals possessing juvenile hormone activities. Insects, Prof. Williams says, would have little defense against a chemical of that sort and they would find it hard to raise defenses against their own hormone as they do against DDT or other insecticides.

The discovery of hormonal activity in American paper products came when Dr. Sláma, a Czechoslovakian scientist, came to Harvard to collaborate with Prof. Williams in a study of the juvenile hormone. He brought 1,500 individuals of Pyrrhocoris apterus, a European bug, with him. He had studied the bug for many years.

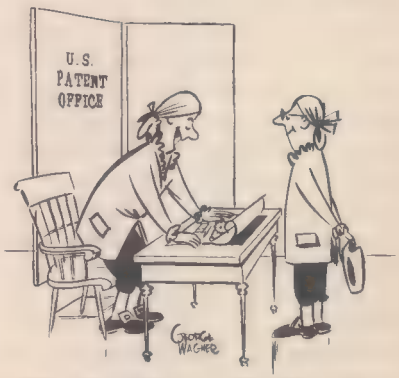
When reared at Harvard, however, the insects failed to change into adults at the end of the fifth larval stage. Instead, they grew into giant, but immature, larvae which died without being able to reproduce.

The scientists traced the hormone down to a small piece of paper towelling that had been placed in each rearing jar. When it was removed, the hormone effect disappeared and insects developed normally.

The two scientists tested 20 brands of American towels and papers and 18 showed high juvenile hormone activity. Sláma and Williams reported that paper from *The New York Times, Boston Globe* and *Scientific American* showed extremely high hormone activity. However, the *London Times* and *Nature* (an English publication) and other European and Japanese papers did not work.

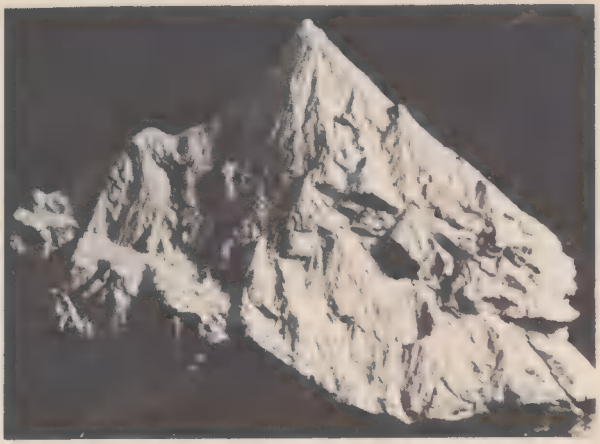
The Harvard scientists found that the principal source of the hormonally active factor was the balsam fir. They found a partially purified extract of the material was active even when applied to the unbroken skin of a European bug. They calculate that an ounce of impure extract would block the metamorphosis of three billion Pyrrhocoris bugs.

The active ingredient in the paper materials has proved to be totally inactive when tested on American insects. This raises the possibility that the hormonally active material may be used to destroy insects selectively.—*J. R.*



"Frankly, Whitney, I like the whole cotton-picking idea."

Clue to a gigantic crater



CONE-shaped rocks called "shattercones" (above) may provide the clue to the origin of a gigantic crater-like structure in middle Tennessee. The basic question is whether the so-called Wells Creek structure is actually a giant crater caused by a sizable meteor or the result of an underground explosion. The results of both occurrences often appear similar and millions of years of erosion have masked the original cause.

Since 1962, two geologists from Vanderbilt University have been studying the two-mile wide structure, near the south bank of the Cumberland River about 50 miles northwest of Nashville, under a grant from the National Aeronautics and Space Administration.

NASA is interested in the Wells Creek structure because it is one of those earth features that resemble those on the moon, and thus it might help relate moon surface history with earth surface history. There are a fair number of earth structures which may be eroded meteor craters.

The Wells Creek structure is generally believed to have been caused by a meteor slamming into the earth at a speed of about 25 miles per second some 50 to 250 million years ago. The shattercones that have been found in the vicinity lend credence to this theory although no meteorite particles have been found. Shattercones are created by very high shock pressures and have often been found in areas of known meteor impacts.

KFS

KFS

What nature teaches man

Human builders have learned a great deal from the structure of the fragile jellyfish and the armored turtle.

by Irwin Ross

MAN IS still young in world history, and nature can teach him a great deal. Up to now he has assumed that he must improve on nature if he wants to progress; but lately a new spirit of humility has given engineers and designers a desire to learn everything nature has to teach. So they are busy examining the earth's flora and fauna for useful tips.

The late Frank Lloyd Wright believed that building construction of tomorrow can reach new heights of beauty, strength and economy if we will only profit by nature's examples. In plants and animals, he pointed out, paper-thin tubes, rods, sheets and membranes hold up under enormous loads.

Take the lowly blade of grass, for instance. Thousands of centuries ahead of us in using the principle of corrugation, it withstands wind and rain simply by having a V-shaped cross section.

Nature found the principle so practical that she uses it in countless ways. One of the loveliest and most efficient plants is the morning glory, with five corrugated blades radiating upward from the stem,

"The walnut," says one designer, "is something to think about."

held together by tissue-thin curved sheets. Yet this is not for beauty alone. The morning glory's great moment comes when a bee makes a sudden crash landing in its open mouth. The little flower, being "built" to handle impact stresses through its corrugations, takes the blow easily, and delivers pollen according to plan.

Wright designed a factory whose roof is supported on concrete pillars deliberately copied from the morning glory. These thin-stemmed supports flare into broad discs at the top, giving the factory a Martian look. But it is one of the simplest and strongest structures in the world.

Effective trick

Wright and others have also adopted an effective trick of nature in her use of the continuous surface. Living structures never display sharp angles; everything is joined by curves. Nature knows her engineering, since an angular break in a surface puts gigantic stress at the point of the angle. Yet man has used the angular break because we needed flat, horizontal floors supported by vertical beams.

Today's designers, however, are switching over to smooth curves. A gas station in South Carolina designed by architect James Workman looks like a mushroom. Its hollow, cylindrical room is the stem, while the roof extends several feet in a circular shelter, sweeping up in an unbroken curve from the rounded walls. Corrugated rings help stiffen the flat top.

Fred Severud has designed an enormous plane hangar that follows the morning-glory pattern, with the outer edge drooping until it touches the ground. The circular space between stem and rim is an arched vault without columns, giving great roominess and strength. Continuous surface is the secret. In this, too, he uses an idea borrowed from nature's lily pad—a "tension ring" of stiff material around the outside.

We admire the thin shell of the hen's egg for its miraculous strength, yet the secret of the egg's curves was not much used until the Navy adapted it to the Quonset hut. About the same time, Buckminster Fuller developed his "Dymaxion" houses, supported above ground by sheet-metal skins.

But nature has several structures better than the egg. The turtle shell is half an egg, with stiffness assured by a "tension plate" underneath. Still better is the walnut shell, expressly designed to be hard to crack. Humans have found no cleverer way to get strength without weight. To the naturally rigid dome-shape of the egg, the nut tree adds a compression ring around the middle, then heavily corrugates the

surface so it can't be dented. Inside, two tension plates at right angles give still more rigidity.

"The walnut," says Severud, "is something to think about." In soft ground, he points out, you could build wonderfully strong house foundations simply by sinking a concrete half-walnut shell, open side up. No angles, no beams; merely an oval-shaped skin in the ground. Its tension-plate stiffener would be the ground floor of the building; from there on up, you could erect a square or curved structure.

Another steal from nature is the design for the Baltimore arena, a pancake-shaped building of tremendous area whose roof has no supports at all—except air. Proposed by engineer Herbert H. Stevens, the building's design imitates the membranous sacs of the jellyfish. It needs no stiffness because it is supported everywhere by pressure from inside.

Stevens merely seals the building and pumps in a slight excess of air. The magnesium plates of the roof float as safely as jellyfish in the sea. And the pressure is so slight that the audience would never even notice it.

Occasionally men spend their lives trying to emulate nature, only to find her secrets too well guarded. Surprisingly, this was the case with the airplane. From Icarus onward, people thought the only way to fly was to invent flapping wings like the bird's. Countless experimenters came to grief before Lilienthal and Langley had the courage to break away from nature and try the unnatural rigid-wing principle.

Perhaps if the aviation pioneers had gone to Midway Island in the Pacific, they would have found the solution to their problems much sooner. On that island lives a strange family of birds called goonies. As big as turkeys and not very intelligent, they have the clumsy habit of getting off the ground exactly as the airplane does—with stiff, extended wings.

All over the island thousands of goonies pick out clear runways on the beach, then run along the sand for all they are worth. Once they get up flying speed they take off in a low climb, then begin to flap their wings like ordinary birds. In landing, they glide down to contact, then run madly to lose speed, sometimes ground-looping in the effort.

"Funny—how snakes like to bask on sunny ledges."

QUIZ

Which is older —the earth or the sun?

by John and Molly Daugherty

A SPACE capsule is now being designed to take samples of soil from Mars, analyze them chemically, and transmit the analyses back to us. Then we'll know whether there's any microbial life on Mars.

How much of the present knowledge of the solar system is yours?

1. There are many theories about the origin of the solar system. For the past twenty-five years, the new theories lean toward saying:
   a. The planets originated about the same time that the sun formed.
   b. The sun originated first—before the planets formed.
   c. The planets originated before the sun formed.
2. The outer planet in our solar system that has no known satellite is
   a. Neptune
   b. Uranus
   c. Pluto
3. One form of motion of the earth affects the seasons over a span of about 13,000 years. The word involved in describing this motion is
   a. Parallax
   b. Aberration
   c. Precession
4. Most of the planets orbiting around the sun lie in a plane close to that which the earth follows—the ecliptic plane. One planet, however, is way out in its inclination to the ecliptic plane. That planet is
   a. Mars
   b. Pluto
   c. Jupiter
5. The more elliptical the path of the orbit of a planet becomes, the greater the eccentricity of the orbit. The inner planet that has the lowest eccentricity (the closest approach to a circular orbit) is
   a. Mercury
   b. Venus
   c. Earth
6. According to some modern theories, the sun may last for ten thousand million years or longer. During this long time interval the sun will
   a. Show no evidence of change
   b. Get hotter
   c. Cool off
7. Eclipses of the sun and moon are rare even though you might expect the possibility of one each a month. The line-up of the moon, earth, and sun is infrequent because the moon's orbit plane about the earth is tilted about 5 degrees to that of the ecliptic plane of the earth's orbit. In one year there are
   a. More solar than lunar eclipses

KFS

Many solar system secrets have been probed by big Mt. Palomar telescope.

b. More lunar than solar eclipses
c. Equal numbers of each

8. Early in 1979 one planet will trade places with another planet in the order of its distance from the sun. The exchange will last about twenty years. The planet which will be superseded temporarily in this exchange is
   a. Jupiter
   b. Uranus
   c. Neptune
9. The average distance of the planet Neptune from the sun is thirty times the distance of the earth from the sun. The intensity of the sun's radiation on Neptune compared to the sun's radiation on the earth is
   a. 1/27,000th as great
   b. 1/30th as great
   c. 1/900th as great
10. Of the nine planets, the one which may have been a satellite of another planet before it became independent is
   a. Mercury
   b. Pluto
   c. Mars

Answers:

1—a The planets originated about the same time that the sun formed. The older concept about the solar system, namely, that the planets are younger than the sun, introduced many ideas difficult to explain. Newer theories say, in brief, that the solar system originated in nebula—a huge cloud of gas, mostly hydrogen and cosmic dust. The cloud became denser by condensation, with the future sun at the center and various miniature condensations eventually to become planets. The larger future sun became a true star, and the minor condensations, ultimately losing heat, became cold planets.

2—c Pluto. No satellites of Pluto have been discovered. Uranus has five satellites, and Neptune, two. Küiper discovered the fifth satellite of Uranus in 1948 and the second of Neptune in 1949.

Among the four inner planets, neither Mercury nor Venus has a satellite. Mars has two, and the earth only one—the moon.

3—c Precession. As the earth spins on its axis, the north pole points to a certain star, but like a spinning top, the earth wobbles. It takes 26,000 years to complete one wobble; that is, the axis executes a circle about a vertical line while the tilt of the axis is still maintained at 23½ degrees. During the precession—sometimes referred to as the precession of the equinoxes—the axis gradually points to different stars. In one-half of a precession, 13,000 years, in that part of the earth's orbit where we now have winter we shall then have summer.

4—b Pluto. Pluto is inclined 17-degrees to the plane of the ecliptic, and Mercury is inclined seven degrees. But all other planets vary between less than one degree and about three degrees in following the same plane of orbit the earth does.

5—b Venus. The orbit of Venus is almost circular. Its eccentricity is only .007 in contrast to the earth's .017 eccentricity. Mercury's orbit is very elliptical with an eccentricity of .206, exceeded only by Pluto with .249—the highest among all the planets.

6—b Get hotter. On our time-scale of life, we shall not notice any in-

crease. But near the end of time for the sun, the increase in the intensity of radiation may scorch the earth and boil the oceans away. It then may take a few million years for the atomic fires to die out.

7—a More solar eclipses than lunar. There can be no more than seven total eclipses a year. Sometimes we do not get a full quota. Whenever there are five solar eclipses in one year, there is a minimum of two lunar eclipses. If a lunar eclipse occurs, everyone on earth sees it, but when a solar eclipse occurs, the shadow cast by the moon falls across the earth's surface in narrow belts so that few see the phenomenon.

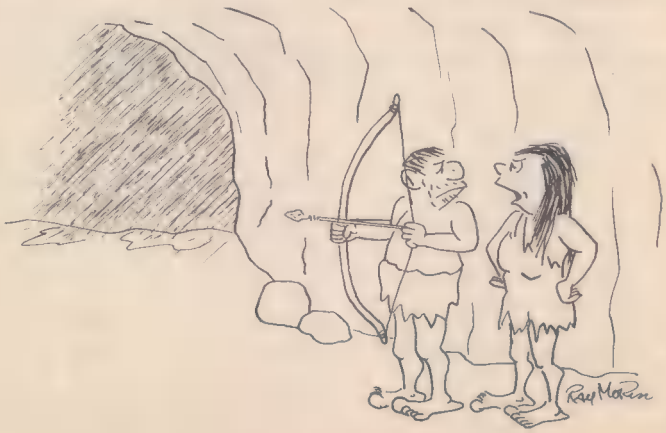
8—c Neptune is the eighth planet in distance from the sun. Because of its great eccentricity, Pluto at its nearest approach to the sun will be inside of Neptune's orbit by more than 60 million miles. Thus for this twenty-year period Pluto will be planet number eight, and Neptune, number nine. There will be no danger of collision when the exchange occurs since Pluto is inclined about 15 degrees to the orbit plane of Neptune.

9—c 1/900th as great. The amount of radiation varies inversely with the square of the distance from the source. Neptune is thirty astronomical units from the sun and by definition, the distance of the earth from the sun is one astronomical unit. Thirty squared equals 900, and one squared equals one. Therefore, Neptune receives 1/900th as much.

10—b Pluto. All the planets beyond Mars except Pluto rotate at a rapid rate, varying from about 10 to 16 hours. In 1956 Küiper calculated the period of rotation of Pluto to be 6.23 days. This longer period is probably due to the fact that Pluto was once a satellite of Neptune and retained its rotation when it became an independent planet.

Score Yourself:

9—10 right—Excellent.
4— 8 right—Average.
0— 3 right—You didn't get into orbit.



"Ever since you started fooling around with that thing, we've had nothing but crazy weather!"

Don't fear the machine

It is not often that I have had the inclination to take exception to points of view expressed in your magazine. However, I find myself, as a person involved in the field of cybernetics and simulation, inclined to sharply disagree with the alarmist position taken by Alan Smith in his article "Can We Improve On Nature Too Much?" (Oct. '65).

However wonderful future machines become there are two things they are unlikely to have. The first is the human passion for command, the second is the human passion for consumption. Since organization is impossible without command and production is inefficient without organization; and since production is pointless without consumption, may I suggest that whatever logical extremes to which we wish to carry these two propositions, it is impossible to visualize a world which does not have a distinct place and role for human beings.

There is a residual effect he also ignores. By being able to produce a machine which can simulate the creative process we can develop a sufficiently detailed understanding of this process to vastly improve the training programs which develop the process in man.

It is often characteristic of the alarmists to assume, correctly, that the potential of the machine is only just beginning to be explored, while they assume, wrongly, that the potential of human development has been reached. It may be that at some future time the relationship between man and machine will be more like that of business partners than that of master and slave, but such a relationship does not in any way imply the end of humanity. In fact, it might conceivably spell the beginning.

JAY POWELL
Edmonton, Alberta
Canada

Propaganda

Your book review of "The Troubled Calling, Crisis in the Medical Establishment" (Sept. '65) should have been titled, "What's wrong with Greenberg (the author)?" rather than "What's Wrong With Doctors." Did you purposely omit the question mark?

So adequate medical treatment is a basic human right, eh? Also food, clothing and shelter? Nuts!

May I conclude that the medical reporters and editors of magazines are not protecting us innocent readers against socialistic propaganda?

EDWARD N. HORR
Hickory, N.C.

First time?

In "Inside Psychiatry Today" (Oct. '65) you make the statement "For the first time the mentally retarded are finding their way into federal government employment." What do you mean "for the *first* time!"

JOHN R. LEND, M.D.
Chicago, Ill.

Women in science

I am writing in reference to the article by Dr. Ruth B. Kundsin, "Why Nobody Wants Women in Science" (Oct. '65). I found her article just exactly what she had hoped it would be, "a provocative article on a subject that is real, important and controversial." But I think it is more than that. It is a most revealing psychological study of a somewhat resentful woman who, despite her admittedly notable achievements in her particular field, is still licking the battle wounds collected in her upward climb to recognition and prestige. I think when the battle fatigue of such a struggle has amply seeped out of Dr. Kundsin's mind that a few hours of conscious self-analysis and introspection will reveal to her the full impact of what she is asking of a completely unready society.

It is my opinion that most women, even under different circumstances, would not wish to aspire to such heights of recognition as Dr. Kundsin advocates. This is a reaction due to a healthy satisfaction with lesser goals.

I agree that women are regarded with some disfavor, more curiosity and often a little contempt in business and other fields which were formerly man's sole domain. This is, I believe, a healthy reaction on the part of modern man to his reduced circumstances. Strip a man of his male ego and pride and I'm sure you would behold a most unbecoming and totally repulsive creature. What is more, you would not be happy with your creation.

Being a good mother is no menial task as Dr. Kundsin seems to infer. It is a noble, challenging task that should be worthy of anyone's talents, however great, should a woman decide to attempt it. We need educated mothers who are content to attempt the task of rearing their children in an acceptable manner to meet the challenge of our age!

DR. PRESTON A. GIGGIE,
Upper Woodstock, N.B.
Canada

Dr. Ruth B. Kundsin's article really shows a woman's displacement.

Let's hope that all women aren't needed in science.

W. F. FISHER
Houston, Texas

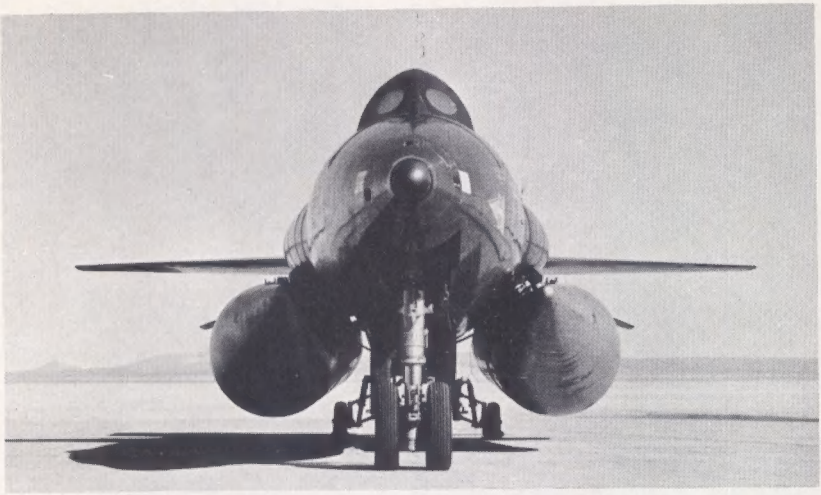
Speculations

The concept of a universe of opposite signs is a little far fetched ("Is There A Second Universe?" Sept. '65). Assuming a balanced void. what happened to make one particle assume a negative sign and another assume a positive sign? Nobody can comprehend the world "infinity" and nobody can comprehend this phenomenon or what caused it. I think you are just talking to hear yourselves talk and to invite letters from a batch of half-baked idiots like the writer.

But if you are bent on speculation about another universe consider the proton and electrons that make up our atoms. These may be solar systems in a minute universe. And likewise our solar system may be an atom in a molecule that we call the Milky Way in an infinitely larger universe.

You can really go to town when it comes to speculations of this sort. But we have enough to learn and explain by sticking to what we already know.

RALPH M. SHAW, JR.
Beverly, N.J.



Two 25-foot-long, 1,800-lb. fuel tanks have been added to the underside of the fuselage of the X-15 rocket plane to give it increased engine burning time and speed.

5,000-mph plane

With two bulbous fuel tanks fastened to its underside the X-15 experimental rocket plane is eventually expected to reach a speed of 5,000 mph. The tanks, which will contain some 13,500 lbs. of propellant (anhydrous ammonia and liquid oxygen), will be jettisoned as the plane reaches a speed of 1,400 mph and an altitude of 69,000 feet. At present the X-15 is being flown with empty tanks to test tank ejection procedure and recovery.

The tanks are reusable and after separation from the X-15 each of them will deploy a 34-foot parachute for descent to a bombing range area for recovery.

Following an accident in 1962, the No. 2 X-15 was repaired and modified. One modification included the two external propellant tanks. The added propellant is expected to increase engine burning time from 85 to 145 seconds, thereby raising the speed to Mach 8, or about 5,000 mph. Present maximum speed of the X-15 is slightly over six times the speed of sound (Mach 6). The airplane has reached a top speed of 4,104 mph.

In the future the X-15 may undergo a major configuration change. In the concept now under study by NASA, a severely-swept delta wing with vertical tips would replace the short stubby wings of the aircraft and the fuselage would be lengthened to include a larger propellant tank.

In this issue . . .

T.V. personality and world traveller Hugh Downs returns this month with reflections on how to save the world from over-mechanization. Page 80.

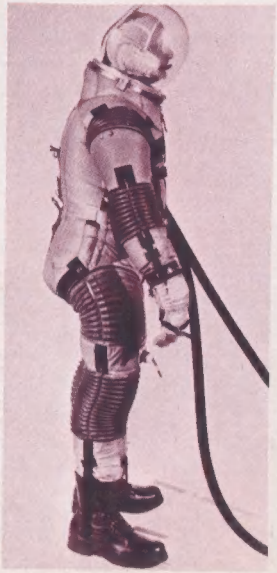
The unique kiwi is an apt symbol for New Zealand, for these isolated islands contain the world's oddest birds. The story of this strange and exotic avian collection begins on page 57.

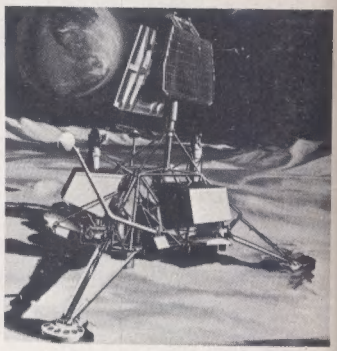
In Cambridge, Mass., engineers, scientists and businessmen are using scientifically-directed bull sessions to turn wild ideas into workable products. Find out how it's done in the story on page 61.

Old, yet young, Rensselaer Polytechnic is one of the nation's leading science schools. Page 64.

Psychiatrists are attacking the problems of youth by studying 'normal' adolescents. Page 18.

A new type of space helmet will make astronauts 'bubble heads.' It's just one of the many recent developments in space technology pictured on pages 26 and 27.





Sometime this year the U.S. hopes to have a Surveyor spacecraft sitting on the moon taking T.V. pictures of its surroundings. Page 16.

Today astronomers are making more discoveries than at any time since the invention of the telescope. Test your knowledge on page 92.